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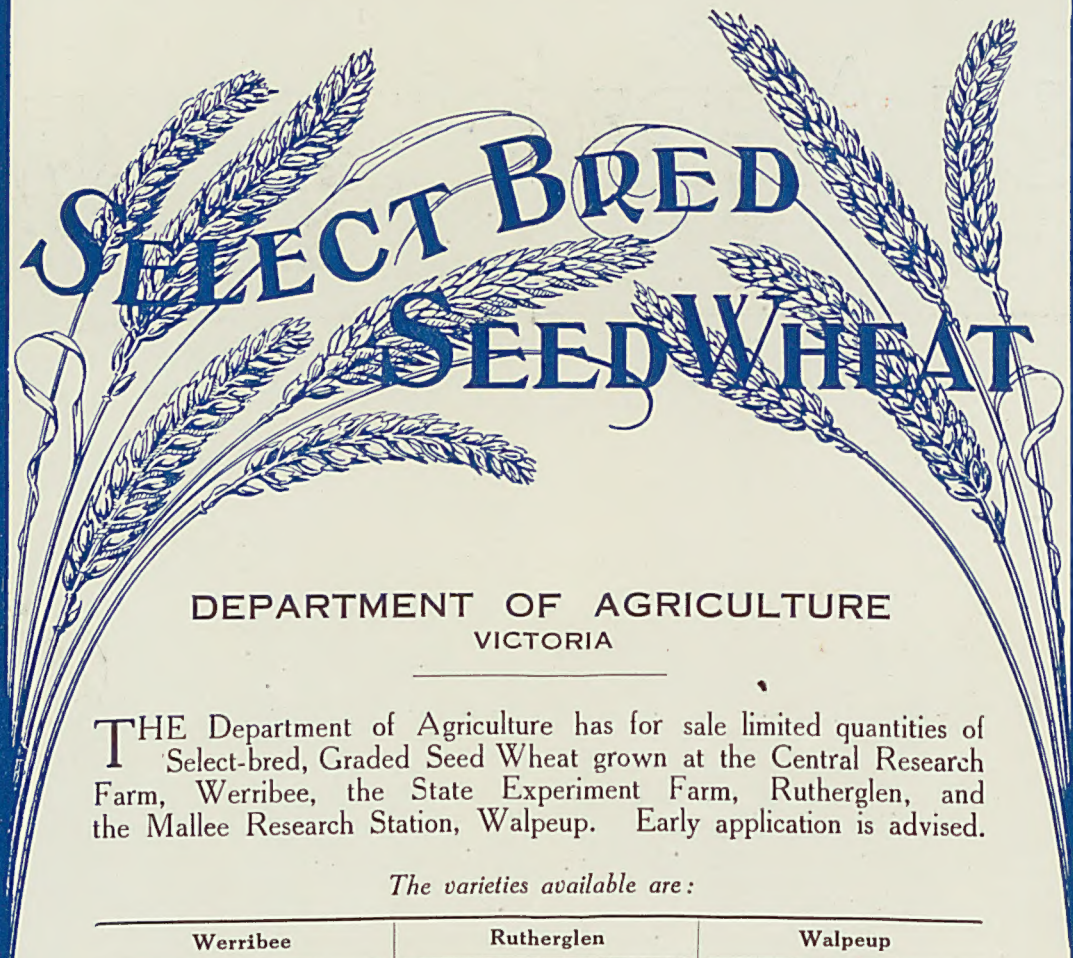

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Issued under the direction of the Hon. E. J. Hogan, M.L.A., Minister of Agriculture.

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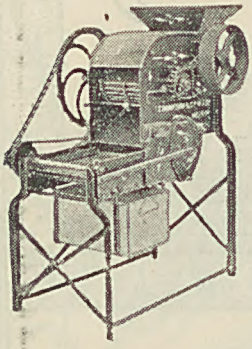

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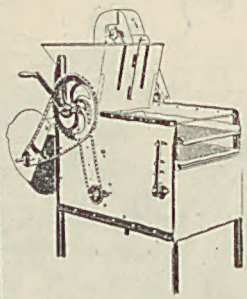

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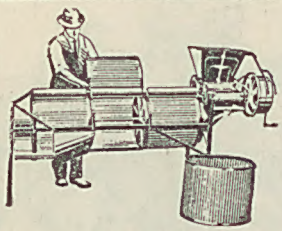

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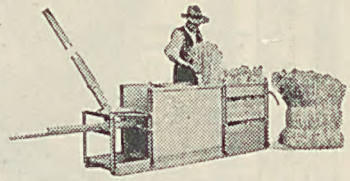

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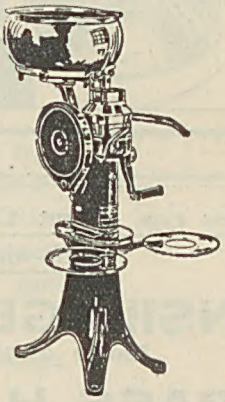

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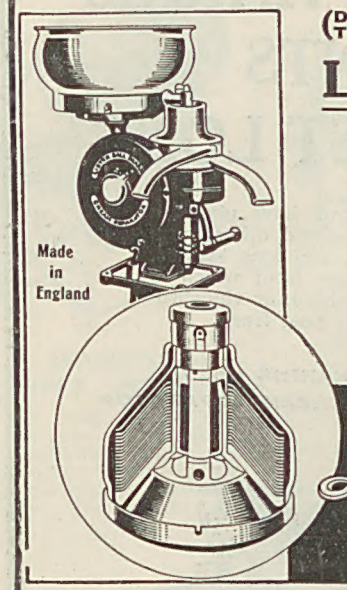

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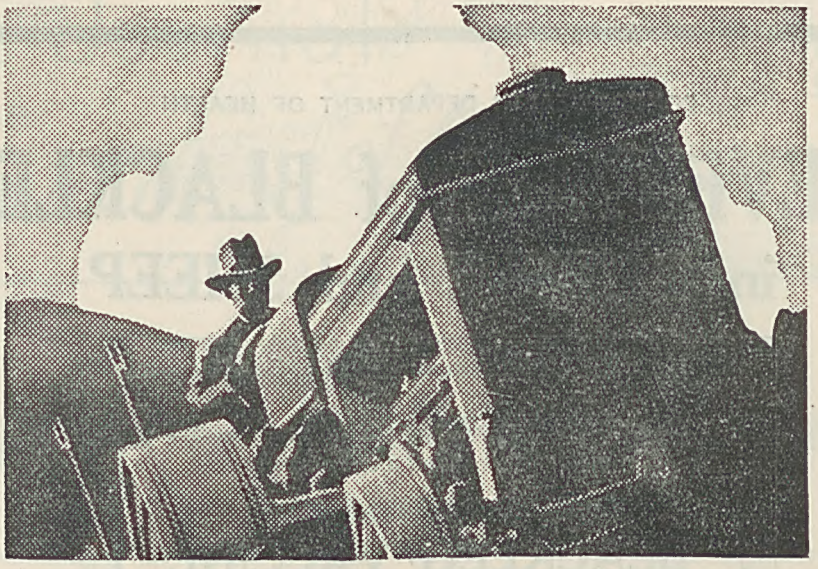

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The Journal of the DEPARTMENT of AGRICULTURE of VICTORIA

Improving Victoria's Pastures

By R. L. Twentyman, B.Agr.Sc., Agrostologist

The following is an outline of some results of the investigations carried out by the Victorian Department of Agriculture in conjunction with the Pasture Improvement League.

A "PASTURE" has been described as "*grass,* growing for the feeding of cattle or other animals," but it is rarely that the pasture is restricted to grass species only—usually there is present also a varied collection of clovers and weed species. According to the conditions under which the pasture is growing, some or other of these species will tend to dominate the sward. Pasture improvement usually has as its object the encouragement and stimulation of the useful species and the elimination of their competitors.

Pastures vary in composition according to the locality in which they are situated, the nature of the soil on which they are growing, the previous treatment of the land, the manurial dressings given, and the method of grazing to which the pasture is subjected. With so many factors controlling the balance of growth, it will be readily appreciated that pastures will vary greatly among themselves, and indeed not only is almost every paddock different from the adjoining one, but frequently there are large variations in the composition of the pasture within the one paddock itself. For this reason, in recommending methods of pasture improvement one should have a very definite knowledge of the type of pasture in question, for although there are general lines which pasture improvement usually should follow, in most cases some modification of the usual methods is required in order to obtain the most effective results.

It was largely to obtain information of the response of pastures under widely diversified conditions in Victoria that the Victorian Department of Agriculture began the programme of work in conjunction with the Victorian Pasture Improvement League. This League, which was formed late in 1931 largely owing to the activities of the late Dr. S. S. Cameron, consists of a number of organizations directly interested in the prosperity and welfare of the dairying and pastoral industries. At that time a great deal of publicity was being given to results which were being obtained in the improvement of pastures in New Zealand. There, heavy artificial manuring, the sowing of new and improved strains of grasses and clovers, the vigorous harrowing of the pasture land, and the adoption of the intensive rotational method of grazing had vastly increased the production of the pastures.

The Victorian Pasture Lmprovement League was convinced that the main factor essential to the success of the dairying industry was the establishment and maintenance of vigorous productive pastures. It was considered, therefore, that efforts should be made to ascertain to what extent, if any, the New Zealand practices could be adopted with advantage in Victoria. Following on many years' work in demonstrating the value of top-dressing pastures with superphosphate, the Victorian Department of Agriculture had instituted investigations

into some of the newer practices which were claimed to be of benefit, particularly the use of nitrogeneous fertilizers on pastures and the value of the intensive rotational grazing method, and had obtained considerable information as to the value of these practices under local conditions.

To enable this work to be extended, the Pasture Improvement League provided some financial assistance, but the actual experimental work is carried out by the Department as an independent authority, retaining full control of the direction of the work and accepting full responsibility for all reports which might be issued by it.

Owing to the limited staff available, the initial work was restricted to the southern dairying districts. In order that the experiments should cover a wide range of pasture types, 46 different experimental plots were established. These plots were of two types, eleven major plots, each consisting of 7 acres, while the smaller pilot plots were each only ⅛ acre in area.

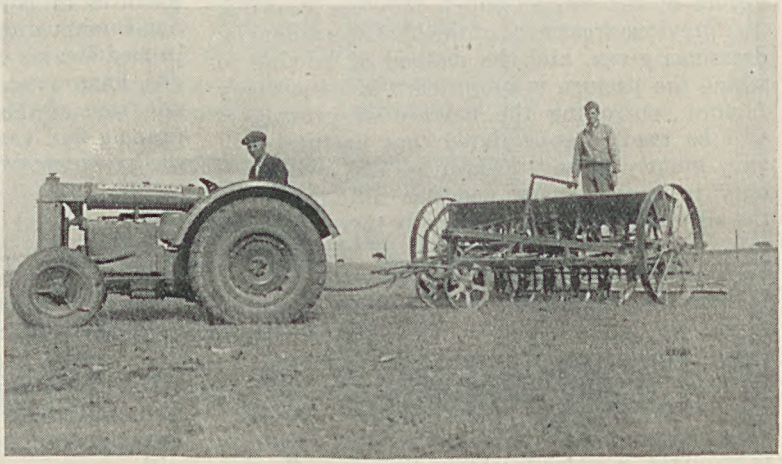
Each major plot consisted of three sections—the rotational grazing demonstration plots; a quantitative manurial section; and the pasture mixture and species section. The pilot plots were laid out on a uniform plan, and included a manurial test and a pasture mixture and species trial only.

On the major plots the trial with the artificial fertilizers was divided into two parts. The rotational grazing demonstration section consists of four small paddocks, each approximately 1 acre in area, to each of which various fertilizer treatment has been given. The produce of these plots is grazed off by means of dairy stock, and records are kept of the amount of grazing which each area provides. When these grazing trials were commenced, it was hoped that the number of "grazing days" obtained from each plot would serve as a measure of the growth on each, but it was soon found that, owing to the preference the stock usually showed for the feed on the top-dressed plots, the time spent on each area did not necessarily indicate the amount of grass consumed.

While these plots have illustrated the beneficial effect of the frequent change of paddocks, they have shown that, under Victorian dry pasture conditions, it is most difficult to control the growth on the pastures during the spring. Under New Zealand conditions, growth is slower, but more prolonged, and rotational grazing can be practised for quite a long period. On our pastures, however, growth during the spring is of short duration, but is so rapid that it is almost impossible to keep it at the 4-5-in. stage, and, even with the assistance of the mower, it soon gets out of hand, and becomes stemmy and mature.

In the second section of the major plot manurial trial, the productivity of the pasture is measured directly by cutting the grass on the plots with a motor mower, and weighing the produce obtained. In this trial the plots consist of narrow strips side by side, to each of which various manures have been applied. To measure the growth on each plot, two mower widths are cut out of each, and the total produce per plot calculated. It may be thought that with the narrow strips the neighbouring plots would benefit from the manure applied to the adjacent plots. This is not the case, however, as, owing to the readiness with which the manure combines with the soil, it is immediately held by the soil with which it comes into contact, and there is no lateral movement of the fertilizer.

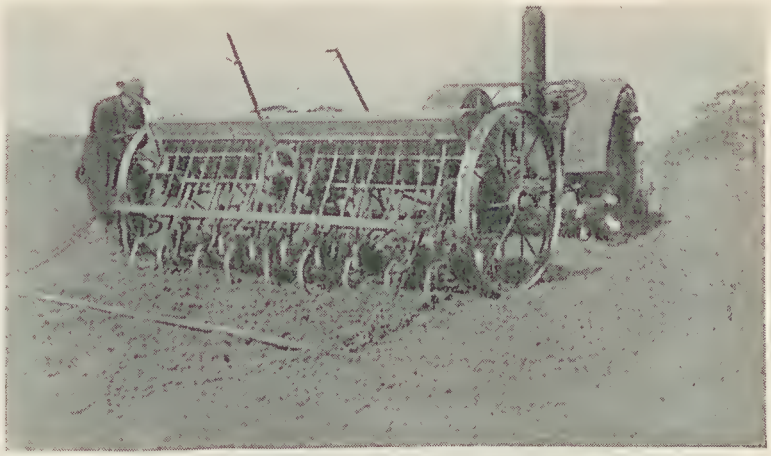
For the purpose of comparison, these quantitative manurial plots include untreated strips, strips that have received varying quantities of superphosphate, and others which, in addition to superphosphate, have been treated with



Sowing subterranean clover at Trawalla.

either lime, potash, or sulphate of ammonia. By means of these trials it has been possible to obtain accurate records of the immediate response of the pasture to the various manurial dressings.

The most consistent results have been obtained from superphosphate, and in many cases the response has been really spectacular. Generally, the clovers increase, the pasture is thickened up, and growth is greatly increased. Even more important is the fact that this increased growth is most marked during the lean winter and early spring periods. In a few instances the response to superphosphate has been unaccountably small. More recent results indicate that in such cases there is usually some other soil deficiency limiting growth, and it is not until this is remedied that the full benefit from the superphosphate can be obtained. Instances of this nature have been most marked on the red hill country of Gippsland, particularly where the pasture consists of cocksfoot and red clover. Plots established on such pastures, both at Warragul and North Mirboo, have given little response to superphosphate alone, but where a dressing of lime also has been given an excellent response has been obtained. A similar condition has arisen on some of the plots in the Western District, where it has been found that, although superphosphate alone has given a good response, the addition of potash has greatly increased the growth of the pasture.



Subterranean clover establishment by surface working of native pasture.

To determine whether these results are generally applicable to the pastures in those districts, additional experimental plots were established at Warragul and North Mirboo, in Gippsland, and at Colac and Cobden, in the Western District, during the past winter, and already sufficient evidence has been secured to indicate that the earlier results obtained will apply to many of the pastures in those districts.

Nitrogeneous manures, mainly in the form of sulphate of ammonia, have been extensively tested throughout these experiments, and, while they usually have given a rapid response, particularly when applied during the winter or early spring, the increased growth generally is followed by a period of depressed growth, which largely offsets the value of the stimulus given. While Victorian pasture soils are almost invariably deficient in nitrogen during the winter and early spring period, it is only under exceptional circumstances that the use of nitrogeneous fertilizers on pastures would be economic.

A supply of soil nitrates is just as essential for plant growth as are phosphates or potash. Fortunately, the leguminous plants in the pasture, i.e., the clovers and trefoils, are capable of extracting nitrogen from the air and storing it in the soil for the use of the pasture as a whole. The vigour of production of a pasture, particularly during the winter, is largely dependent on the rate at which this nitrogen can be made available, This is one reason why pastures should consist of a mixture of grasses and clovers since, in the absence of the clovers the pasture will be starved for nitrogen, and will present a yellow, unhealthy appearance while growth will be at a standstill.

In the majority of cases neither lime nor potash has shown any beneficial result, but there have been a few instances where, used in conjunction with superphosphate, both of these materials have given very good results. Previously it had always been considered that Victorian soils were plentifully supplied with potash, and that there was little possibility of any improvement resulting from its use. The results of these pasture trials have shown clearly that this assumption is not justified, and it appears that a shortage of soil potash

Mowing experimental plots at Warncoort.

may be largely responsible for the condition of soil exhaustion that appears after prolonged cropping.

In the Western District plots, particularly on the lighter soils that respond so well to superphosphate, potash is becoming increasingly important on the mowing manurial trial areas. Here the method of harvesting the plots is for all the produce grown to be cut and weighed, and removed from the plot, and there is no return of plant food to the soil in the form of animal droppings, such as would occur if the pasture were grazed off by stock. Treated in this way, there is a heavy drain on the potash supply of the soil, and after the third year of such treatment the potash deficiency on some of these plots has become very marked.

Under ordinary farming methods, a similar condition is reached when a pasture is repeatedly cut for grass hay late in the spring. If this grass hay were fed back on to the paddock from which it was cut, no harm would result, but this seldom happens, the animal droppings and the contained plant food usually being concentrated about the yards, and particularly the night paddocks, with little or no return to the paddock from which the grass hay was cut. Potash fertilizers are expensive, and it would appear that if their use is to be avoided in the future it will be necessary to avoid excessive waste of the natural potash supply in the soil. At present the avoidance of the practice of cutting the same paddocks year after year for grass hay, the spreading of droppings in the paddocks by harrowing, and the prevention of the excessive accumulation of droppings and farm-yard manure on limited areas, will do much toward maintaining a sufficient potash supply in the pasture soils.

Although conditions in southern Victoria are not so favorable for pasture growth as those experienced in the pasture districts of New Zealand, they are much better than are found in most other parts of the world. Except for the period of summer drought, some growth can be obtained almost all the year round, and, though soil fertility usually limits the growth of the natural pastures, the improvement that can be effected in these pastures by merely top-dressing with superphosphate and the sowing of subterranean clover is remarkable. This practice has been mainly responsible for the vast improvement which has been brought about during the past ten years in the pastures of southern Victoria, where in almost every district are to be seen examples of improved productive pastures separated only by a fence line from the adjoining almost worthless native pasture.

The nature and vigour of growth of a pasture are largely a reflex of the condition of the soil upon which it is growing, and one cannot expect to maintain a strong growth if soil conditions are unfavorable. Most farmers have as their ideal a pasture consisting of rye-grass and white clover, and, though it is true that such a combination is usually found on our best pasture land, there are very few areas in this State capable of maintaining such a high-class pasture on non-irrigated land. In most cases much more satisfactory results will be obtained by using a mixture of rye-grass, cocksfoot, and subterranean clover. In any case, a mixture must be selected that is suitable for the soil and climatic conditions offering. If species demanding high fertility are sown under poor soil conditions, they will not grow strongly enough to compete with the weeds, and will soon be choked out. In this regard subterranean clover has proved a most useful plant, for not only is it able to establish itself under poor-soil conditions, but, assisted by top-dressing with superphosphate, it rapidly builds

[*Continued on page* 18.

Irrigated Pastures at Rochester

Competition Results

Report of the Judge—A. Morgan, B.Agr.Sc., State Research Farm, Werribee

ROCHESTER is an old-established irrigation district, but in recent years striking changes have been made there, particularly in respect to the development of irrigated pastures. An important factor in promoting this development has been the annual pasture competition conducted by the Rochester Agricultural and Pastoral Society.

Apart from the continued expansion of the area devoted to this purpose, a feature of the pastures is the luxuriance of the particular large-leaved strain of white clover which appears to be spreading rapidly in the district, where it is encouraged by liberal manuring with superphosphate and intelligent watering methods. Indeed, some growers profess alarm at the possibility of its spreading so rapidly as to suppress the grasses in the mixtures. In connexion with this, the first two years' results of a test at Werribee should prove of interest. This test showed that a month's rest between mowings (and, it is inferred, between grazings) provides the best fodder value and maintains a good grass-clover balance in the pasture without reducing the yield of greenstuff.

The pasture tested was an old cow pasture top-dressed annually with 2 cwt. superphosphate per acre, and receiving 2 feet of water per acre per annum. The test, therefore, was of wide application, particularly as the pasture mixture was of the standard rye grass-cocksfoot-white clover type, with a proportion of volunteer prairie grass. This test was made the subject of a comprehensive exhibit at the recent Royal Show, and the results were put

Judging a pasture on Mr. E. Watson's property.

ROCHESTER PASTURE COMPETITION. — BEST PASTURE PLOT (NOT LESS THAN 3 ACRES).

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E. Watson (1) ..	19½	16	19½	19½	19	93½
A. W. Glass ..	19	19½	15	19	19½	92
H. A. Schier ..	19	17	17	19	19½	91½
Firth Bros. ..	18½	19	17	18	18	90½
E. Watson (2) ..	19½	15	18	19½	18	90
D. Holman ..	19	18	15	19	18	89
A. L. Clymo ..	19½	15	19½	19	15	88

out at the annual Field Day at Werribee, and may be found in the Werribee Guide-book. A full report will be published later, but in the meantime the above brief statement may be taken advantage of by those interested in maintaining a satisfactory grass-clover balance in their pastures.

One handicap from which many of the pastures inspected will suffer in respect of the successful application of the monthly grazing method is the poor representation of cocksfoot. It will be readily appreciated that cocksfoot, a summer-growing species showing a vigorous response to summer watering and to superphosphate, will be more efficient in keeping the white clover in check than will perennial rye-grass, which grows well in spring and autumn, but is not sufficiently active in summer. As pointed out by some exhibitors, the grasshopper plague has aggravated the grass deficiency severely in some cases. The system of monthly grazings, with intelligent variation in times of rapid growth, when allied with meadow hay production, should go a long way towards solving this problem of balance of species in a practical and inexpensive manner.

Mowers were much in evidence throughout the inspection, and it must be pointed out that some of the finest exhibits as regards mixture and uniformity were spoiled from the exhibition point of view as pastures because they had perforce been allowed to reach the meadow hay stage. It seems that the November judging should be followed by a second judging at the end of the irrigation season. Under this system, any weaknesses in watering and grazing management would be exposed, and all pastures would be in the pasture stage, and the interesting comparisons offering at that time should be productive of valuable discussion, which after all is one of the main objects of the competition.

This explanation is given because the points allotted for mixture and condition of the pasture, as shown in the accompanying table, have had an important bearing on the final placings of the various exhibits.

The winning pasture exhibited by Mr. E. Watson, was sown in the autumn of 1930, with the mixture recommended by the Department, plus 5 lb. lucerne. The mixture recommended by the Department is the following:—

	lb. per acre.
Perennial rye-grass (Victorian or New Zealand old pasture seed) ..	10
Cocksfoot (Victorian or New Zealand old pasture seed)	5
Italian rye-grass	3
New Zealand perennial red clover ..	2
New Zealand white clover.. ..	1
Alsike clover	1
Subterranean clover	1
Strawberry clover	¼

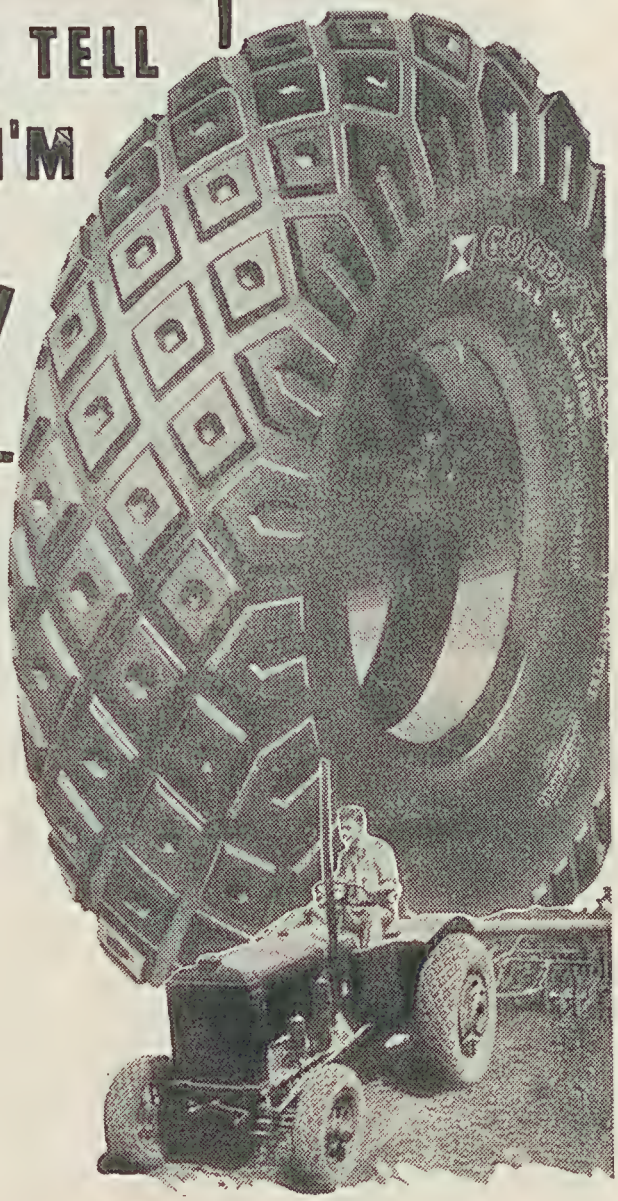
This mixture, with the addition of the lucerne at the rate of 5 lb. per acre, was sown with 1 cwt. of superphosphate on an old lucerne stand after taking off a crop of oats. In addition to top-dressing each year with a bag of superphosphate per acre, 1 ton of lime was given in two applications this year.

Mr. Watson's dairy herd is grazed two to three days on each field, and after each grazing the paddock is watered and mowed. Although this pasture lost points for condition, it was excellent in all other directions.

Second prize went to Mr. A. W. Glass, whose interest in permanent pastures dates back many years, and began under other skies. His pasture has been down ten years, and was established on old lucerne land. The mixture was a standard one as regards species, except that Kentucky blue-grass was added, and strawberry clover omitted. The absence of weeds was noticeable, and although the "bloom" had been taken off the pasture by 25 head of stock during the previous night, the condition was good. The mixture was weak

Showing the situation of the pigsties over the irrigation channel on the property of Mr. A. W. Glass.

LISTEN! I'LL TELL YOU WHAT I'M DOING FOR FARMERS!



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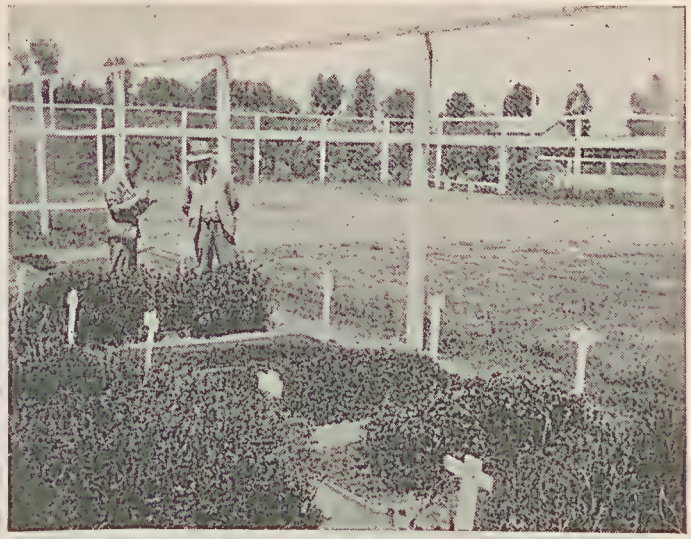
THE 5-POWER PETROL

P539

on account of the deficiency of cocksfoot, and the annual types of rye-grass were rather too evident. These comments are to be taken more in the manner of constructive criticism than as being derogatory to the exhibit, of which the owner may well be proud. Top-dressing with 2 cwt. of superphosphate is carried out annually, and careful attention is paid to the all-important frequent watering during the hotter months.

A novel feature of this field was the situation of the pigsties over the irrigation channel, providing a quick drainage of liquid manure, which was flushed on the pasture. Apparently this method has not proved detrimental to the health of the pigs, and Mr. Glass stated that the grass content of the sward had benefited largely. In an adjoining field the large-leaved strain of white clover was very much in evidence.



Portion of the pasture plots at the Nanneella Estate School.

Mr. H. A. Schier's pasture, which gained third place, was sown in April, 1932, with a mixture of Hawke's Bay and Italian rye grasses, cocksfoot, and a mixture of clovers, on old lucerne land after a crop of oats. It has received two bags of superphosphate and approximately 2½ feet of water per acre per annum, the waterings being frequent in the hotter months. Sixty cows had been grazing on the 8 acres until a few days before the inspection. Even following this grazing, the pasture was rather too long, and this feature, together with a deficiency of cocksfoot, went against this excellent pasture in the judging.

Several exhibitors commented on the good recovery of the white clover from the grasshopper plague of last year, while the rye-grass recovery was poor. This is unfortunate in view of the aggressiveness of the local strain of white clover, similar in type to that occurring at Dingee. Soft brome grass was very evident in pastures so affected and allowed to go to the meadow-hay stage.

School Plots.

A subsidiary pasture competition at Rochester is one in connexion with the pasture clubs at the district State schools. At several of these the children have laid down small plots of the standard grasses and clovers sown singly. In most cases about a dozen are included, and they have proved a splendid means of promoting interest in pastures.

Four entries were submitted this year, and Nanneella Estate school won first prize with an excellent exhibit, with which it was difficult to find any fault. The rye grasses were somewhat uninviting, owing to having been left too long awaiting inspection, but were true to label and weed-free. A few plants of *Trifolium striatum* (knotted clover) occurred in one box.

A sample of prairie seed was shown in one case, and this seed, although apparently clean and healthy, had refused to germinate. It was suggested that seed harvested by the pupils from local plants of this grass would prove more satisfactory, and would serve to illustrate to them the almost endless variety of forms which occur within a single species—forms which differ widely in their agricultural value. Some instruction on the part of the teachers on the desirability of leafiness, disease resistance, and so on, would then round off an interesting experiment.

A total of 50 points was obtainable, and the awards were as follow:—

Nanneella Estate	49½
Strathallan	48
Ballendella	46
Nanneella West	40*

* No labels erected.

Dairying and Dairy Research

In Europe, America, and New Zealand

By G. Loftus Hills, B.Agr.Sc., Dairy Technologist

Mr. Loftus Hills recently returned to Australia after visiting dairy research institutions in Europe, America, and New Zealand. This trip, which was financed by the Victorian Government and the Australian Dairy Council, was undertaken primarily to acquire knowledge of dairy research technique in other countries.

SINCE it would be impossible in the space available to give anything like a complete account of the institutes, factories, &c., visited during the course of this trip, and since purely technical information would be of value only to dairy technologists, the general position of dairying in the countries visited will be dealt with, and the research being conducted in this sphere will be broadly outlined.

England.

In spite of her huge imports of dairy products, England herself produces some 1,000,000,000 gallons of milk per year, 70 per cent. of which is consumed as milk and 30 per cent. used for manufacturing purposes, chiefly condensed and dried milk and fresh and tinned cream. England produces less than 10 per cent. of her consumption of butter, and that is produced chiefly on the farms. Factory butter manufacture has made little progress, due apparently partly to conservatism of the farmer and partly to the fact that other forms of dairy manufacture are more profitable.

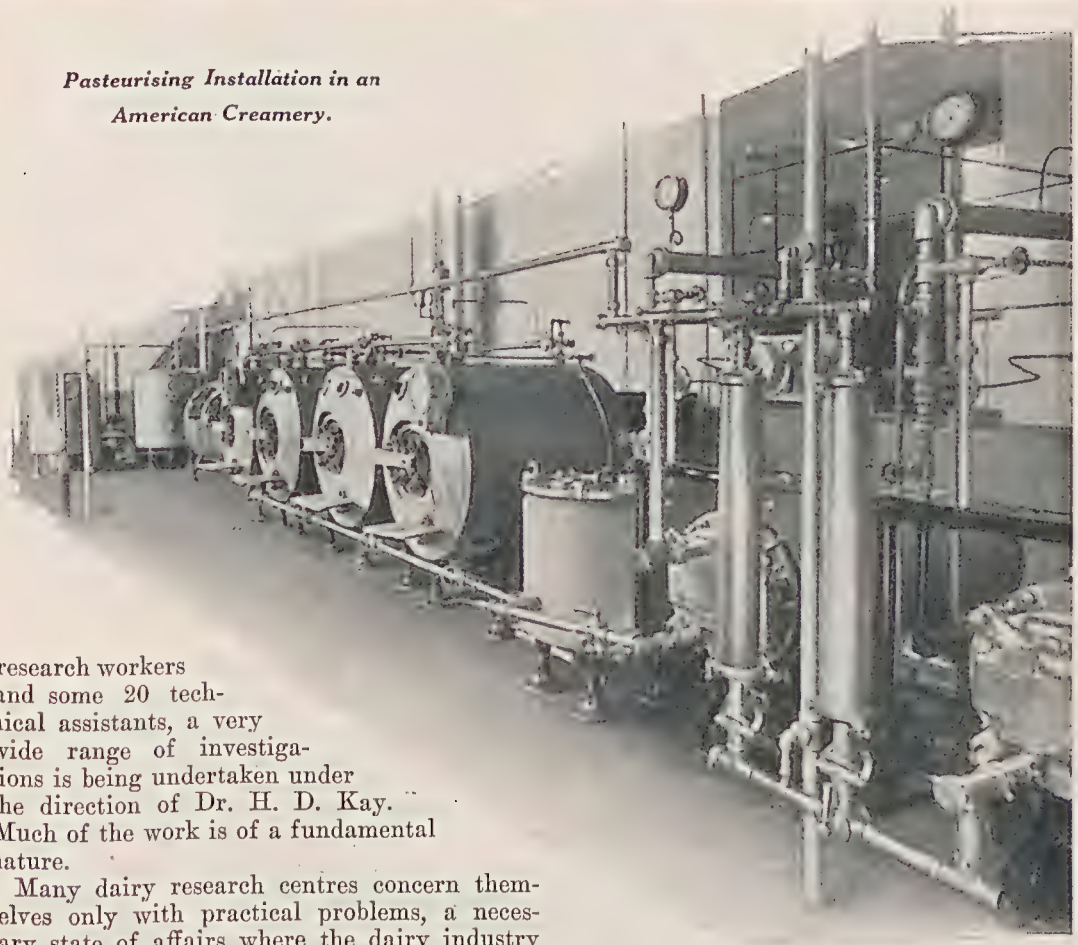
The Milk Marketing Board, which now handles all commercial milk, has arranged a levy on retailed milk in order to support dairy manufacture, which, consequently, has been greatly stimulated. Five large milk-drying and condensing plants visited in the south of England were all carrying out considerable extensions. The following extracts from the chairman's report to the Milk Marketing Board early this year give some interesting sidelights on the effect of the Board's policy:—

"The Board has given careful thought to the scope for the sale of manufactured dairy products in this country, and you will be surprised to know that even in the short period of the Board's existence our own manufacturers are already producing more condensed milk, milk powder, and fresh and tinned cream than the market absorbed from all sources in 1933, when the Board came into operation. New uses have been found for all these products in industry, but there are still vast quantities of processed milks coming into this country from overseas, and the Government has been asked to prohibit these supplies to give our own manufacturers the opportunity of supplying the market with British milk. Unless this is done, practically every extra gallon of milk now produced must be made into butter or cheese, the two products which return the lowest prices."

"... the entrance into the milk market of producers in mixed farming and cattle feeding areas has not only had a depressing effect on Pool prices, but may have serious consequences on agriculture as a whole in this country. ... Unless cattle feeding becomes more remunerative to producers, I can see increasing quantities of milk being produced in this country. I sincerely hope the Government will arrange that beef production is once again made profitable, for this will go a long way to settle the problems of the rearing districts, and to some extent relieve our market of additional surplus milk."

The milk drying and condensing factories in England usually operate on a large scale, and are splendidly equipped, modern American plants being used in many instances.

In the National Institute for Research in Dairying, at Reading, England possesses one of the finest dairy research institutes in the world. What was formerly the Shinfield Manor House has been splendidly adapted to the needs of research. With a staff of about 25



Pasteurising Installation in an American Creamery.

research workers and some 20 technical assistants, a very wide range of investigations is being undertaken under the direction of Dr. H. D. Kay. Much of the work is of a fundamental nature.

Many dairy research centres concern themselves only with practical problems, a necessary state of affairs where the dairy industry is faced with problems which can largely be solved by existing scientific method and knowledge. But since the adage "Progress, or cease to exist," is as applicable to dairy science as to any other undertaking, there is a necessity for work on the problems of dairy science as distinct from the problems of dairying, problems that are chemical, bacteriological, physical, or physiological, but which clearly cannot be left to the chance interest of investigators in these fields. Reading, in tackling some of these problems, is increasing the value of dairy science throughout the world.

A complete study of the variations in chemical composition of the milk from a typical herd over a five-year period was recently completed. This provides basic statistical information not previously available. Study of the seasonal variation in vitamin content of milk and butter has given much information of direct value, and has led indirectly to a new knowledge of spectroscopic phenomena in the fatty acid metabolism of the cow. Investigation of the metabolism of lactic acid bacteria has provided a basis for the fundamental study of cheese ripening now being undertaken. Research into factors affecting fat oxidation should shed light on the practical problem of producing butter of good keeping quality.

Through the courtesy of the Institute at Reading, the writer was able to spend three months there studying the causes of the occasional instances of deterioration which occur in Australian butter during transit to England. As indicated by an earlier cold-storage experiment in Melbourne, the chief factors are hydrogen ion concentration (pH) and copper and iron content. Although no very definite quantitative results should be taken from the number of samples examined, it appears that butters with a pH of less than 6.8, a copper

content of more than 0.15 parts per million, and an iron content of over 1.5 parts per million are distinctly more likely to deteriorate than butters not exceeding these limits.

Bacterial action was found to be responsible for deterioration in many instances. Such action will not occur under the temperature conditions in the hold of the ship, but during freezing and thawing and the time which elapses before the butter is disposed of there are apparently sufficient opportunities for bacterial alterations to occur. Some of these butters were salted, but the majority were not. Deterioration of Australian unsalted butter after arrival in England is in fact a common occurrence, particularly where the butter is reworked or blended. European unsalted butters are much more stable owing to their being made from ripened cream, and consequently having a pH of about 4.5 to 5.0, sufficiently low to inhibit the action of many bacteria. Australian and New Zealand unsalted butters, as at present manufactured, are unfortunately very susceptible to bacterial action, having neither salt nor hydrogen ions to check the organisms. Unless extreme care is taken to prevent contamination during manufacture, deterioration will probably occur if the butter is held for any length of time at room temperature. Work in America has suggested that it may be advisable to partially ripen cream for the manufacture of unsalted butter, even where it is to be cold stored for considerable periods.

Among the bacterially altered butters obtained from the butter agents in London was a sample of "rabbit-o," a particularly objectionable butter defect known also as "decomposed meat aroma." The causative organism was isolated by a method previously developed here, and the opportunity was taken to study and classify it. A characteristic red pigment production on potato-agar was observed, and this may possibly be useful in its future detection in butter factory surveys. Later, at the Iowa Agricultural Experiment Station, examination of cultures isolated by Derby and Hammer as the cause of surface taint, a fairly common butter fault in Canada and to some extent in the United States, showed that these were identical with the "rabbit-o" organisms.

The Hannah Dairy Research Institute, at Ayr, in Scotland, although only a few years old, had already done valuable work on the drying of milk, and particularly on the control of the solubility of milk powder. Study and classification of organisms causing defects in condensed milk and tinned cream will provide basic information of wide application. Chemical analysis of proteins commonly fed for milk production has shown that lysine is the only amino acid likely to be deficient in a normal diet to an extent sufficient to limit milk production. Work on the proteins of grass is proceeding. Valuable work on the control of mastitis and contagious abortion is being conducted there, and the results are being applied under practical conditions.

At Auchincruive, nearby, Dr. Leitch has for many years been studying the cause of cheese defects, including "stinking cheese," not unheard of in Victoria, due apparently to a variety of sporing anaerobes. Besides securing cultures which can be relied on to produce the typical Somerset cheddar type, Dr. Leitch has been experimenting with a cheese of the cheddar type, using a starter of *Bacillus acidophilus* in place of lactic acid streptococci. The resultant cheese has a very mild and attractive flavour.

Holland.

Dairying has been more seriously affected by the economic depression in Holland than in any other important dairying country. About 40 per cent. of the butter made in Holland used to be exported. With restrictions in France, quotas in Germany, and prices too high for Belgium, little of their export trade remains. An attempt is being made to build up a market in England, and though Dutch butter is little known there, and the growth of trade is necessarily slow, the quality of the butter is so good that a satisfactory market must ultimately be secured. But last year the position was so serious that 200,000 cattle were slaughtered; this year another 100,000 were destroyed—drastic action in a country in which dairying is a leading source of national income. The manufacture of Edam and Gonda cheese has suffered similarly but less severely.

The majority of Dutch dairy factories are on a co-operative basis, and in order to organize the industry more effectively, to secure greater power in dealing with the Government, and to advertise their products, these co-operative factories have united into the Algemeine Nederlandsche Zuivelbond, otherwise the "F.N.Z." This body consists of a number of local associations which control the quality of the product, supply technical information to the factories, and hold classes to train the operatives. Control of the chemical purity of the butter-fat

is delegated to the "F.N.Z." by the Government, and this is achieved by regular sampling of the butter, and the execution, amongst other tests, of Reichart Woolny tests on the fat, the result being compared with an annual curve obtained from each factory over a number of years. Issue of the National Butter Brand is dependent on attainment of the necessary standards of quality and purity.

Dairy research is carried out at the Government Experiment Station at Hoorn and at the Agricultural High School at Wangeningen, under Dr. Van der Burg. The time available allowed only the latter to be visited. Work on the effect of small variations in copper and iron content on the quality of butter shortly after manufacture leaves no doubt about the serious consequences of metallic contamination. Other investigations in progress are concerned with improved methods of rennet manufacture, and the effect of bacteria in causing loss of power in rennet, commonly thought to be due to the effect of light.

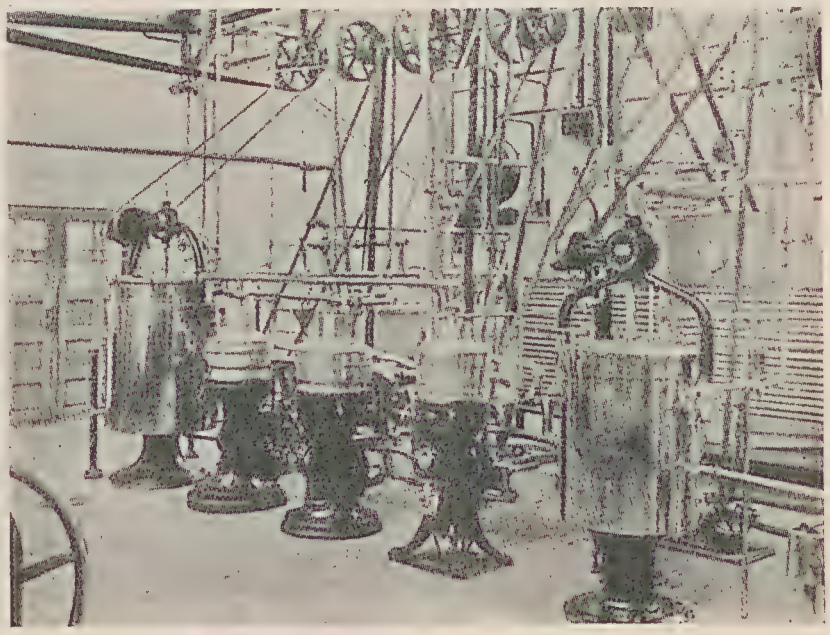
Denmark.

The characteristic features of dairying in Denmark—co-operation, thorough training of young farmers, delivery of milk to the butter factories from distances usually less than 5 miles, flash pasteurization, ripening of the cream with starter preparatory to churning, utilization of skim-milk and butter-milk for pig and chicken feeding, very rapid and efficiently organized marketing, and uniformity of supply throughout the year—are too well known to need further description. Although in April of this year Denmark regarded butter manufacture as a losing proposition continued merely because it was an essential link in her whole system of agriculture, existing prices and the recent contract with Germany must have materially improved the situation.

Technical control of dairy manufacture in Denmark is not very extensive. All milk is subjected to the methylene blue test, and paid for on this basis, and samples of butter regularly taken for competition grading purposes are subjected to chemical and bacteriological examination. With an acid butter reaching the consumer in a week or so, bacterial action is much less important than in Australian butter. As would be expected, yeasts, favoured by the low pH, are rather more important as a cause of deterioration.

Dairy research has always received the attention it deserves in Denmark. Bang, Orla-Jensen, and Soncke Knudsen are names as famous as any in dairy science. The Bioteknisk-Kemiske Laboratorium of the Polyteknisk Laereanstalt, in Copenhagen, directed by Professor S. Orla-Jensen, is investigating problems in many food industries besides dairying, but is best known for its work on the lactic acid bacteria. Study of the nitrogen and vitamin requirements of these organisms recently completed suggests explanations of some of their peculiarities of behaviour in dairy practice.

Professor Soncke Knudsen, at the Royal Veterinary and Agricultural College has worked chiefly on the problem of keeping quality in butter, and has had considerable success with the use of the Catalase test as an indication of the tendency of butter to deteriorate at normal temperatures.



Separator room in a Danish butter factory.

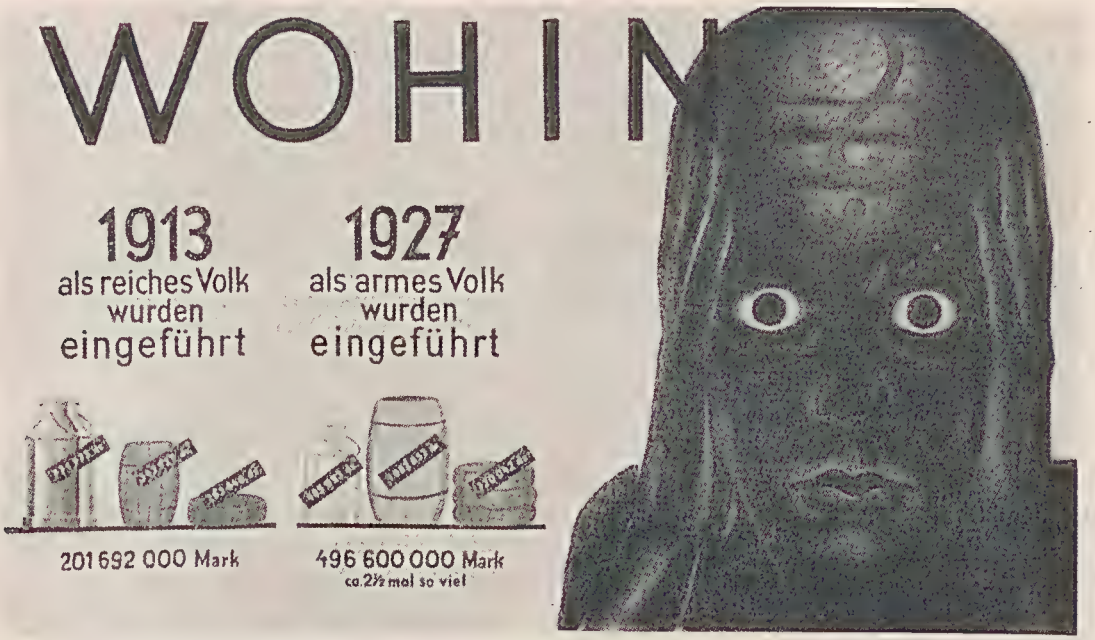
The dairy industry in Denmark co-operated with the Government to erect a splendidly equipped experimental factory at Hillerod, with facilities for practical experiment in many branches of dairy manufacture. Although the factory seems to be largely run in a routine manner, recent work on the relative effectiveness of various methods of pasteurization has established the value of "Stassanisation," and useful work on the influence of feeds on the consistency of butter has been accomplished.

Portion of the Dairy Research Institute at Kiel, Germany.

Germany.

Every effort is being made in Germany to reduce the extent to which that country is dependent on imported fats, and dairying, therefore, is being expanded as far as possible. Up till 1931, about 100,000 tons of butter were imported per annum; last year the figure was 60,000, and Germany's own production 420,000 tons, which greatly exceeds that of Australia. This year a poor season has again rendered necessary large imports. About 30 per cent. of Germany's production is farm butter, but factory manufacture is being encouraged by price-fixing, the figures in April of this year being 2s. 4d., 2s. 3d., and 2s. 2d. per lb for the three grades of factory butter, and 2s. per lb. for farm butter. Butter marketing used to be in a somewhat chaotic condition, but new regulations fixing the price at the factory, as well as to the consumer, are designed to prevent speculation, and also to render it most profitable to sell in the nearest markets, and thus avoid unnecessary transport. Butter is stored in Germany during the months of maximum production to meet the winter demand. No

Two German posters showing, left, incorrect and right, correct methods of caring for milk.



A German poster advocating increased production of dairy products. It reads—" Where to ?—In 1913 a wealthy people imported dairy products costing 201,692,000 mark—In 1927, a poor people imported dairy products costing 496,600,000 mark."

modification is made in the method of manufacture, which closely resembles the Danish, but in spite of the high acidity the keeping quality is apparently fairly satisfactory.

In the Presussische Versuchs und Forschungs Anstalt für Milchwirtschaft, at Kiel, Germany has the best equipped dairy research institute in the world. Divided into seven sections dealing with Production, Utilization, Dairy Engineering, Chemistry, Bacteriology, and Physical Science, it covers nearly every field of dairy research. The sections operate more or less independently, co-operating, of course, wherever a problem involves work in more than one specialized branch of dairy science. Microphotographic studies of the physical destruction of the fat globules in milk by lipase derived from the udder and from bacteria, optical work demonstrating the structure of dairy products, investigation of the iron content of butter wash waters and the development of simple methods for its removal, the thorough testing of all machinery, which must meet with the approval of the institute before it can be placed on the market, and the standardization of such articles as milk cans and separators to increase efficiency both in manufacture and use are a few interesting aspects of the wide activities of this institute. Kiel has also undertaken the preparation of pictures and posters with the object of educating and interesting the public in dairying generally, and also for the education of the farmer. Some of these are illustrated.

At Weihenstephan, near Munich, is another large Government research station, and there are many agricultural colleges and technical control stations, the latter organized by the industry, where dairy research is being undertaken. Germany, characteristically enough, utilizes science to the utmost in increasing the efficiency of her dairy industry.

Russia.

Siberian butter only a few years ago was inferior in quality to practically every other brand on the English market. With the introduction of dairy experts from Denmark, Holland, and Germany to Russia to control the methods of production, and with the use of modern Danish dairy machinery, an enormous improvement has been effected, and London agents now speak highly of the quality of Russian butter. About 30,000 tons were imported into England last year.

Officers of the Export Khleb, in Moscow, claim that, although only 130,000 tons of butter

were produced from the registered factories in the U.S.S.R. in 1934, the actual production was probably eight times as much, or over a million tons. They stated, also, that one of the objectives of the second five-year plan is to attain about four times this production. Many of the Kolkoz, or collective farms, operate their own factory, or even several factories. Very little dairy machinery is at present made in Russia, but this, of course, is only a matter of time. Great interest is shown in machinery used in other countries. Butter from many countries, including Victoria, has been imported to Russia to determine the characteristics of butter finding favour in England. Russia is undoubtedly taking its dairy expansion seriously.

There are ten dairy research institutes throughout Russia, but time was available to visit only the Moscow institute. Work there is concerned chiefly with the production of starter cultures to replace those at present imported. Starters showing improved volatile acid and diacetyl production have been obtained. It is reported that an electrical method of casein manufacture has been devised at the institute at Vologda.

Austria.

Dairying in Austria has grown steadily since the war. Imports of dairy produce into Austria in 1924 were valued at £1,900,000. By 1930 the position had so changed that dairy exports were worth £350,000. This growth has been due partly to legislative measures (tariffs, quotas, &c.), but also largely to the better organization of the industry. Some 65 per cent. of the production is on a co-operative basis, and the recent tendency has been towards the formation of large groups or central organizations, both by co-operative and private factories. Legislation designed to prevent price disturbance has brought some measure of Government control to the industry.

The Institute for Dairy Microbiology at Vienna, directed by Dr. Staffe, has done valuable work on alterations in the chemical composition of milk caused by climate and by feed, on the catalase content of milk, and on many local problems. There is an experimental factory for practical research and machine testing at Wolfpassing. Combined with this is an educational institute for the training of factory operatives and dairy farmers.

Switzerland.

Swiss dairy manufacture has consisted almost wholly of the production of Emmenthal and Gruyere cheese and of condensed milk, most of the produce being exported. With the closing of markets and the adverse exchange rate resulting from her adherence to the gold standard, Switzerland has found dairy export practically impossible. This position has been eased to some extent by manufacturing butter instead of importing it. It is interesting to note that where cream is supplied from cheese factories, having been stored for an hour or so in the copper vats used for Emmenthal cheese manufacture, tallowy and rancid flavours are very common in the resulting butter. This has been linked up with the content of copper by Dr. Ritter, working at the Dairy and Bacteriological Institute at Liebefeld, near Bern. Dr. Burri, director of this institute, is the originator of the Burri slope method of culturing and counting organisms. He is investigating the bacteriology and chemistry of the ripening process of Swiss cheeses.

Canada.

Canadian dairying is best known for its cheese production, Canadian Cheddar cheese usually bringing about 10s. more per cwt. than Australian on the English market. Actually cheese manufacture accounts for only 7 per cent. of the total dairy production in Canada. It is carried out chiefly in the provinces of Ontario and Quebec. The factories are small, averaging about 90 tons production per annum, and naturally draw their supplies from a small radius. The milk is graded, but not tested bacteriologically, and it is not pasteurized. Examination of the starters used has often shown them to be contaminated, and the factory conditions are not of the best, yet 94 per cent. of the export cheese graded choicest last year, a triumph of art over science. The superior flavour of the cheese is attributed by dairy technologists there to the use of unpasteurized milk, permitted by climatic and production conditions, and also to feed. As would be expected from the method of manufacture, bacterial defects are more common in Canadian than in New Zealand cheese.

Butter production in Canada is little more than sufficient to meet national needs. Batch pasteurization is usually used, temperatures of 170° for ten minutes, or even 180°, being customary. Acid cream is neutralized to about

0.25 per cent. Surface taint, equivalent to our "rabbit-o," has caused a great deal of trouble. In 1928, 3 per cent. of the butter made in Alberta was affected, and 20 per cent. of the factories experienced the defect. With the recent isolation of the causative organism by Derby, of the Canadian Department of Agriculture, and Hammer at Iowa, the cause of the trouble is understood and its incidence has been greatly diminished.

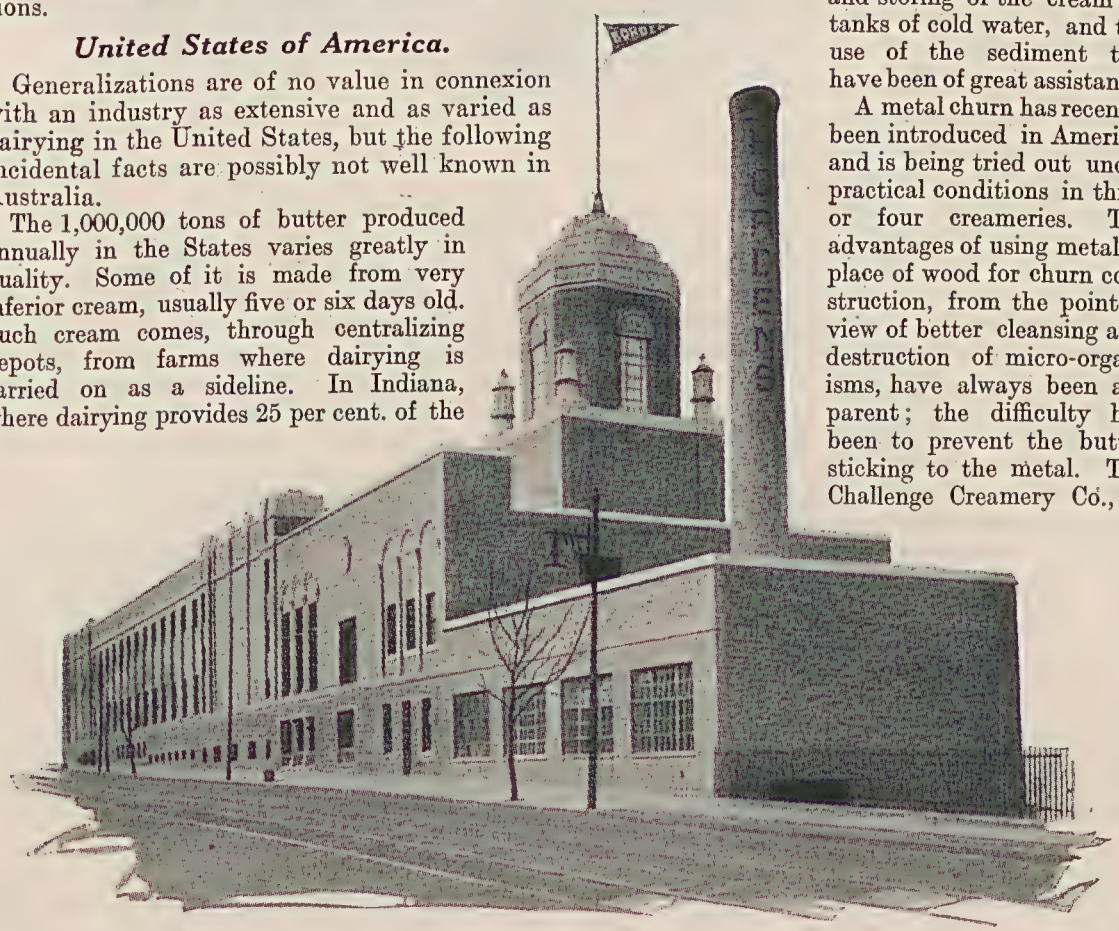
Canada has not the extensive dairy research organization of most of the other countries mentioned, but Hood and White, of the Department of Agriculture, are well known for their work on the use of yeast and mould counts in butter as an index of factory sanitation and for work on cheese defects. The Dominion Experimental Farm, at Ottawa, is studying the use of chlorine disinfectants in farm dairy hygiene, and other problems are being tackled by research students at various agricultural institutions.

United States of America.

Generalizations are of no value in connexion with an industry as extensive and as varied as dairying in the United States, but the following incidental facts are possibly not well known in Australia.

The 1,000,000 tons of butter produced annually in the States varies greatly in quality. Some of it is made from very inferior cream, usually five or six days old. Such cream comes, through centralizing depots, from farms where dairying is carried on as a sideline. In Indiana, where dairying provides 25 per cent. of the farmers' income, the average size of herds supplying cream to the butter factories is four cows. In some States the figure is even smaller. Omaha, the town which makes more butter than any other town in the world, is largely dependent on such cream. Neutralization, pasteurization with direct steam, severe vacuum treatment, and the use of a starter serve to produce an edible butter. At the other extreme, the Land o' Lakes, a huge organization in Minnesota, produces butter made only from sweet cream containing less than 0.2 per cent. lactic acid. A similar organization, the State Brand Creameries, in Iowa, also used sweet cream, but differs in using starter to give flavour to the butter. The sweet cream is obtained on a two- and sometimes on a three-day collection, and this speaks well for dairy extension work in these States and for the intelligence of the dairy farmer. In Iowa, the payment of a bonus for sweet cream, the cooling and storing of the cream in tanks of cold water, and the use of the sediment test have been of great assistance.

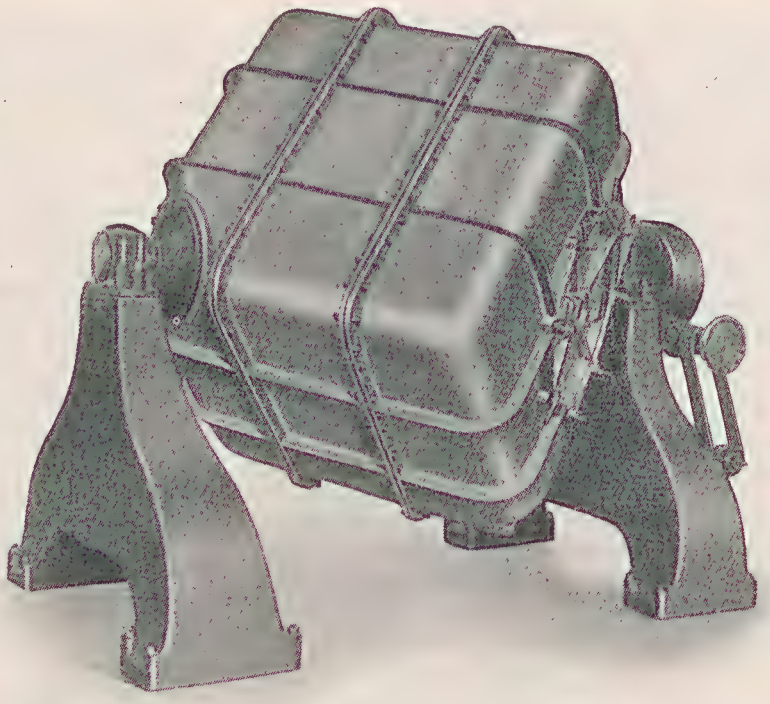
A metal churn has recently been introduced in America, and is being tried out under practical conditions in three or four creameries. The advantages of using metal in place of wood for churn construction, from the point of view of better cleansing and destruction of micro-organisms, have always been apparent; the difficulty has been to prevent the butter sticking to the metal. The Challenge Creamery Co., in



A modern milk pasteurizing and delivery plant at Newark, New Jersey, U.S.A.

California, experienced so much trouble from bacterial deterioration of butter which was traced to churn contamination that their technologists—Mr. Mitchel and Mr. Whetmore—decided to experiment with the adherence of fat to metal surfaces treated in various ways. They finally produced a churn made from a cast aluminium alloy, to which butter will not adhere. This churn is square and is without rollers or shelves of any kind.

The butter is worked by concussion, being repeatedly lifted and allowed to fall. Tests of pound prints made from a churning show maximum variations in salt and moisture of 0·3 per cent., and although the buttermaker at Lemoore, where one of these churns has been in use for two and a half years, had found the texture very satisfactory; a waviness has been observed at other places, and also a tendency to grittiness unless time is allowed for the solution of salt after it is added. Difficulties in working by this system would probably be more pronounced at the lower churning temperatures used in Victoria. Comparison of yeast and mould counts from butters made in this churn and in an old wooden churn operated alongside it revealed only slightly lower figures from the metal churn. Although it is possible that these organisms were derived from sources other than the churn, more evidence is necessary before it can be accepted that the churn has achieved its object.



The new all-metal churn now being tried out by American Creameries.

Cheese production in the States centres in Illinois and Wisconsin, Cheddar and Swiss being the chief hard varieties. Cottage and cream cheeses are also very popular in America, and attempts are being made to popularize locally-made soft-curd cheese, such as the Iowa Blue Vein, really a Rocquefort type. Increasing amounts of the hard cheeses are being tinned immediately after pressing, often in 12-oz. tins. This results in a rindless cheese free from mould, and the additional cost is more than compensated for by the extra price obtained.

Dairy research in the United States of America is conducted both by the Federal Department of Agriculture and by the Agricultural Colleges and Universities in most of the States. The Dairy Branch of the U.S. Department of Agriculture has extensive laboratories at the central administrative buildings in Washington, and an institute for practical research is being erected at Beltsville, a few miles away. Although there is no definite collaboration between the Federal and the various State institutes, the tendency is for the States to concern themselves with problems affecting the branches of dairying predominant in their own domain (such as whole-milk supply in New York State, butter in Iowa, &c.), and to deal chiefly with practical matters, while the U.S. Department of Agriculture deals with fundamental problems and with minor branches of the industry not sufficiently concentrated to inspire work in any one State.

Much of the State dairy research is financed by the Federal Government, and in some cases the investigations to be undertaken must be approved by a Federal Board. The application

of results to industry, extension work, and technical control are left almost entirely to the individual States.

Work at Washington on the development of oily flavour in milk has shown a great variation in the tendency of milk from individual cows to develop oiliness when subjected to conditions favouring oxidation, and the causes of this are now being investigated. The discovery of new uses for lactose, the development of a method of lactic acid manufacture by a process of continuous fermentation, and the concentration and fermentation of whey to produce a pig fodder of good keeping quality are proving most valuable to the industry. Many other matters, such as Emmenthal cheese manufacture, the tinning of cheese, fat oxidation, the quality of acid casein, and alterations occurring in heated milk, are also being studied.

It is impossible to detail the work of the individual States. Research is frequently carried out at the educational institutes, the teaching staff participating, but whole-time research workers also being employed. In most cases, short practical courses for factory employees are held every year. Much of the technical control work and even some research are performed by the industry. In the practical spheres of milk-drying and lactose and acid casein manufacture, American work is outstanding, while on the technical side dairy science is indebted to American research on such matters as the bacteriology of butter, fat oxidation, the biochemistry of starter cultures, methods for the estimation of traces of metals in dairy products, and the elucidation of the causes of many defects.

New Zealand.

The reader will be familiar with the general system of dairying and dairy manufacture in New Zealand. As a much more specialized dairying country facing export conditions similar to Australia, it naturally tends to be a little ahead of us in theory and practice. New Zealand has led the development of the method of butter manufacture characteristic of both countries as well as many other phases of dairy manufacture, legislation, and organization.

The Dairy Research Institute at Palmerston North is financed partly by the industry through the Dairy Board and partly by the Government. With a staff of about 28 working under the direction of Dr. W. Riddet, much valuable work has already been accomplished. The work of Dr. Whitehead on starter cultures is particularly important. It includes the isolation of organisms responsible for slow acid development in cheese making, which curiously enough only produce the effect after the milk has been pasteurized, and the discovery that sudden failure of starters is usually due to the action of bacteriophage. It appears that the phage is always present in the starter, but only becomes active under certain conditions. A method of immunizing the starters against the phage has been developed, but another phage will then usually appear. This may be immunized against, but the process is apparently an endless one, as many as eight phages having been experienced with one starter. Unfortunately, the very active cultures of the type prepared at Palmerston North which have been found so satisfactory for cheese-making appear to be particularly susceptible to phage action. Recent reports suggest that bacteriophage may be responsible for starter troubles in some Victorian cheese factories.

Feed flavours are prevalent in some districts of New Zealand, particularly in the Waikato Valley, and the Dairy Research Institute has been working with the Department of Agriculture in finding the conditions of feeding responsible for this. The co-operation of the factories has been obtained in grading the cream from certain farms for feed on a ten-point scale. The pastures being used on these farms are regularly examined to determine the percentage of the various plants. Although certain species, such as field cress, produce obvious taints, and sweet vernal grass has an effect even when only 5 to 10 per cent. is present in the pasture, it is found generally that feediness is due to excess of clover. The percentage of clover needed to produce a taint varies with the district, being highest on naturally rich soils and lowest on those where the fertility has been partially built up by top-dressing. Experiments to determine the effect on butter flavour of individual pasture species (white and red clovers, perennial and Italian rye, cocksfoot, &c.), and combinations of these are now being started at Palmerston North.

The experimental factory associated with the Institute has proved most useful in studying the causes of openness in cheese and many other problems. The Department of Agriculture has a Dairy Technologist, and there are two laboratories operated by dairy companies

which are concerned mainly with technical control, but have also done some very useful research, notably that of Williams on copper contamination from factory equipment. Short courses are provided at Massey College for the education of dairy workers.

New Zealand is keeping well abreast of the rest of the world in utilizing for her dairy industry the assistance which can be rendered by scientific methods and the now considerable branch of knowledge known as dairy science.

Improving Victoria's Pastures

(Continued from page 4).

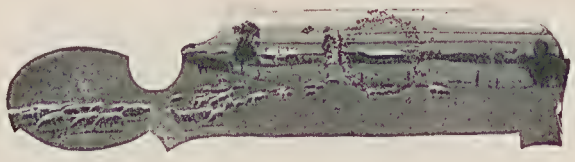
up soil fertility, and is then able to take advantage of the improved soil conditions, and grow luxuriantly.

The sections of the experimental plots sown to the grass mixtures and species have afforded much useful information as to the suitability of the different species under varying conditions. It has been noticed invariably that a much better pasture has been produced where mixtures of grasses and clovers have been sown rather than where they are sown as single species. Further, such mixtures have a more prolonged season of growth, and are more readily grazed by stock, than are the single species. It is not possible in this short article to describe mixtures suitable for various soils and districts—the results of the trials and details of the suitability of the various species as tried for each district are given in the annual report published annually in this Journal.

One of the most noteworthy results of this section of the trials has been the complete success of the local Victorian perennial rye-grass seed when grown in comparison with the imported perennial rye grasses. There is no denying the excellence of the New Zealand Hawkes Bay seed, but in most cases the Victorian seed is its equal in regard to both vigour and persistence. Although cocksfoot was expected to give good results in Gippsland, it has given surprisingly good results in the Western District also, and has helped to produce splendid swards where sown together with perennial rye-grass and subterranean clover. Phalaris was sown on all the experimental areas, but only in a few cases, such as where sown on rich soil or where winter growing conditions were favorable, has it made satisfactory headway.

Early this year extensions of the work under the Pasture Improvement League scheme were made into the irrigation districts of the north and into the light pastoral country in the Western District, but, though this work is now well established, it is yet too early to draw conclusions from the results so far obtained.

The bulk of the experimental work has been in progress for almost four years. In that time much useful information has been obtained, but there are still many problems awaiting solution. Reports of the work and the findings are issued from time to time, and the results are available to those interested in the development and improvement of their pastures.



Blue Mould in Tobacco

Trial of New Zealand Seedlings

By W. J. B. McDonald, B.Agr.Sc., Inspector of Agriculture.

DURING the last ten years, Victorian tobacco growers have been going further and further afield in an endeavour to locate areas in which tobacco seedlings could be grown without infection by the disease, blue mould. Each year, however, it has become increasingly obvious that no part of Australia adjacent to Victoria could be regarded as free from danger of blue mould, and attention has been given to the practicability of producing clean seedlings outside the Commonwealth. Their previous experience had shown growers that problems of packing and transport were not insuperable obstacles to the carriage of seedlings over comparatively long distances.

The fact that blue mould has never been recorded in New Zealand gave rise to discussions between the Victorian Tobacco Growers' Association and the Department of Agriculture, and eventually it was decided to explore the practicability of growing tobacco seedlings in New Zealand for transhipment to this State.

Following preliminary discussions between the New Zealand and Victorian Departments of Agriculture, it was agreed that the New Zealand Department should raise tobacco seedlings at Auckland to enable a trial shipment to be made. The seed was planted in August, and on 17th October the writer left Victoria for New Zealand to arrange for the picking, packing, and transport of the resulting seedlings.

On arrival in Auckland, it was found that, according to the Victorian conception of a tobacco seedling, the bulk of the plants were already oversized, that they had been subjected to considerable forcing in growth, and that throughout their entire life they had been grown under hessian covers. This meant that the plants were particularly soft, sappy, and turgid, were inclined to shankiness, were too delicate for unskilled pickers to handle without damage, and certainly were not in a condition to stand transport for any length of time.

The hessian covers were removed immediately, and there was no option but to wait until the plants were considered sufficiently hard to stand close packing. At the same time, no satisfactory means of arresting further growth could be exploited. The weather subsequently was most unsatisfactory from the point of view of hardening the plants, as it rained on eight out of the eleven days which elapsed before picking commenced. Fortunately, several of the seed beds were much slower than the others in general rate of growth, and from these it was possible to pick a number of plants which conformed more closely to Victorian standards.

Casing.

To avoid any possible quarantine difficulties, special cases to be constructed of new, clean timber were ordered, internal dimensions of the cases being 30″ x 15″ x 9″. The cases were fitted internally with cleats to the side walls, 3″ from the bottom, and with ½″ strips cut to fit neatly across the box. These were designed to take any possible spring out of the mass of packed seedlings. The cases were unnecessarily heavy, as, despite the fact that ½″ material was ordered, the maker delivered the cases made of 1″ material.

Picking.

Picking commenced on 6th November, and was completed on the following day. Had the weather been dry, it would have been possible to do the job in one day, but as it was showery it was necessary to pick all seedlings, and spread them out under cover for some hours to dry before packing. This added greatly to the total time involved, as it necessitated double handling. The actual picking was carried out

by sustenance labour, quite unskilled and inexperienced.

Owing to the softness and turgidity of the plants, it was difficult to lift them without cracking the outside leaves at the point where the stem of the leaf joins the central stalk. These broken leaves when packed served as centres for decay in those cases in which a breakdown of the mass occurred. Approximately 14,000 seedlings were picked.

New Zealand seedlings planted out at Myrtleford.

Packing.

All seedlings were packed according to the following scheme :—

Box 1—*Hester.*—Packed straight from bed during dry spell about noon, roots in Sphagnum moss—box cross battened to prevent movement of seedlings—seedlings packed upright with tops exposed—placed in cool store at 45 deg. F. from 5 p.m. of 6th November, 1935 to 8 a.m. on 8th November, 1935.

No. 2—*Hester.*—Packed straight from bed during dry spell about noon, roots in Sphagnum moss—foliage dusted with peat—box cross battened—cool stored until 8 a.m. on 8th November, 1935, packed as in No. 1. Picked on 6th November, 1935.

No. 3—*Hester.*—Somewhat smaller plants in this box. Packed and treated similarly to No. 2, except that this case was not subjected to any cool storage. Picked 6th November, 1935.

No. 4—*Warne.*—Picked on morning of 6th November, 1935, spread out to dry for four hours. Repacked in standard Victorian manner with the addition of Sphagnum moss to the roots, and a peat dusting to the foliage. Cool stored until 8 a.m., 8th November, 1935.

No. 5—*Warne.*—Picked on morning of 6th, allowed to dry for four hours—packed in Sphagnum moss and peat—roots to the outside, firmly layered with moss—foliage to inside dusted with peat. Seedlings packed on flat, layer on layer, and top of case closed with flat board. Window cut in each end of box to allow passage of air through box and over foliage. Cool stored until 8 a.m. on 8th November, 1935.

No. 6—*Chloe.*—Transported in seedling boxes in which originally seed was struck. Seedlings still growing in original earth—seedling boxes root-bound—soil had been heat sterilized. Not cool stored.

No. 7—*Bonanza.*—Picked on the morning of 7th November, 1935, dried for four hours—bundles of 20, roots in Sphagnum moss, and whole wrapped in paper—foliage dusted with peat. Bundles packed upright, foliage exposed. Not cool stored.

No. 8—*Bonanza.*—Picked on the morning of 7th November, 1935—dried for four hours—bundles of 40—roots in Sphagnum moss, and whole wrapped in paper. Foliage dusted with peat. Not cool stored.

No. 9—*Bonanza.*—Picked on morning of 7th. Dried for four hours. Packed similarly to No. 1, except that box not cross-battened. Not cool stored.

The seedlings were loaded on the s.s. *Wanganella* on the morning of the 8th November, and stored in two first class cabins on B deck. Adequate ventilation was provided. Except for frequent inspections, the cases were not

treated or disturbed in any way until they were finally unpacked.

Cases 4 and 5 exhibited obvious signs of warmth on the fourth day after packing. The centre of the pack may have generated heat prior to this.

The *Wanganella* berthed in Sydney at 10 p.m. on the evening of the 11th November, and the cases were unloaded on the morning of the 12th, being consigned per express train to Wangaratta on the evening of the 12th, arriving on the morning of the 13th. Portion of the pack was transported to Myrtleford by road, and planted out the same afternoon, while the remaining part was transferred to Shepparton, and planted by machine on 14th November.

Seedlings in cases 1, 2, 3, 6, 7, 8, 9 apparently suffered no damage in transit, and as far as superficial observation could determine arrived in perfect order.

In case No. 4, considerable heat was generated, and the heart of the pack degenerated to a decomposed mass. Some decomposition took place in case No. 5, the damage approximating 10 per cent.

Cost of Transport.

The total weight of the pack was 575 lb., of which 180 lb. represented casing. The weight of the cases was unnecessarily great, and could easily be halved. As previously pointed out, the plants were unnecessarily large, and as such weighed a great deal more per thousand than would normal-sized plants.

	£	s.	d.
Shipping charges, which were based on the cubic capacity were ..	1	9	6
Transport charges in Sydney— Transport ship to rail .. .. Harbor dues .. .. .. Customs agent's commission, &c...	1	5	0
Rail freight per express, Sydney to Wangaratta (on a weight basis)..	4	5	1
	£6	19	7

In this figure of £6 19s. 7d. is included a charge of 21s. 6d. for the transport of 400 seedlings in earth. If this amount be subtracted from the total, the cost of transporting approximately 14,000 seedlings, packed free of earth, would be £5 18s. 1d., equal to 8s. 5d. per thousand—a figure unduly high for transport costs alone. Attention, however, is drawn to the fact that the weight and cubic content per 1,000 seedlings were unnecessarily high, due to the nature of the cases and the over-size of the seedlings.

It is estimated that the following quantity of normal-sized seedlings, packed in light cases, would occupy the same space and weigh approximately the same—

On a cubic capacity basis 20,000 seedlings.
On a weight basis .. 28,000 „

On this basis, transport costs for relatively small parcels would be as follows:—

	s.	d.	
Shipping freight — Auckland to Sydney	1	6	per 1,000
Rail freight—Sydney to Wangaratta	2	6	„ „
Other handling charges ..	1	0	„ „
	5	0	„ „

If large parcels of normal-sized seedlings were being transported, it is considered that this figure of 5s. per 1,000 could be somewhat reduced.

Watering experimental plots, Myrtleford.

Cost of Seedlings in Auckland.

In New Zealand, tobacco seed is germinated in small seed trays under glass-house conditions, and when the seedlings have reached convenient handling size they are pricked out into long hessian-covered seed beds. As far as could be ascertained, an efficient worker can prick out up

[*Continued on page* 32.

Arsenical Spray Residue on Fruit

Recommendations for its Removal

By C. E. Cole, B.Agr.Sc., Assistant Horticultural Research Officer

WITH the approach of the apple and pear harvest comes many difficulties which the export grower has to surmount in order that his fruit may reach the high standard demanded by markets in which competition is becoming ever keener. Not the least of these is the problem of producing fruit on which the amount of arsenic is below the tolerance of 0.01 grains of arsenic trioxide per pound of fruit; and, because a little forethought can do much to simplify the problem, it is well that each grower should familiarize himself with all the details of it.

The attack on the problem may take either of the two usual courses—prevention or cure. The main line of prevention is the adoption of the spray schedule recommended by the Department of Agriculture for the control of codling moth, in which arsenic sprays are applied only in the early stages of the growth of the fruit, later ones being replaced by white oil sprays. The grower is assured that such a programme will give not only efficient moth control, but also will reduce the arsenical residue on his fruit below the allowable limit.

In the event of the grower adhering to the older programme for control, the intelligent use of lures throughout the season will assist him to keep the quantity of arsenic applied to the fruit down to an efficient minimum. The longer the period that can be allowed to elapse between the final arsenical spray and picking time, the lower will be the amount of residue on the fruit at harvest. Spreaders which strongly protect the lead arsenate from the action of the weather, e.g., white oil as a spreader, should be avoided after Christmas, as they not only keep the residue figure high, but also render after-picking treatment very difficult. As in most problems, prevention is far better than cure.

The cure becomes necessary when the fruit shows a visible white residue on its surface at harvest time. Generally speaking, the arsenical content of apples showing a plainly visible residue will exceed the tolerance. Rare cases have been encountered in which apples showing practically no residue have exceeded the limit, and of apples showing distinct white spots on which the arsenic trioxide was below the limit. If in doubt, the best method is to obtain an analysis of a sample consisting of those fruits on which the residue appears to be the heaviest. Growers are advised not to attempt to wash the residue off the fruit by means of an oil spray just prior to picking. Such a spray at best could disguise only temporarily the presence of the residue, and would render its subsequent removal far more difficult.

Once the fruit is off the tree, wiping is the most obvious method of removing excess residue, and is used by growers to some extent. It is, however, not only extremely slow and laborious, but usually is ineffective because of the difficulty of removing residues from the eye and stalk of the fruit. One man may wipe up to 50 cases per day by hand with an oily rag, but he more often disguises the residue than removes it. Some of the wiping machines developed recently may be somewhat faster than hand-wiping, but generally are less effective, and gradually lose what efficiency they have, as the residue removed from the fruit collects in the wiping material, until the amount present is equal to that on the fruit entering the machine, when no more will be removed from such fruit. Unless the cleaning materials—usually oily sheepskin or brushes—are frequently removed and cleaned, little is gained by the use of these machines. Brushes, unless used so that the bristles do not come into contact with the fruit while at right angles to its surface, tend to puncture the delicate skin of the fruit. Such punctures allow the immediate entry of mould spores, and the fruit rapidly develops a "pinhole" rot.

The alternative to wiping is the use of a chemical wash, and so far this has proved the most successful method of treatment, not only for the removal of spray residue, but also for the general improvement of the appearance of the fruit. It is more effective and more rapid than hand-wiping—three men working with an average-sized plant (described later) can wash

in one hour as much fruit as one man can wipe in a day, and at much less cost. Comparative costs are discussed elsewhere.

Washing.

Many types of washing solutions have been tried for the removal of arsenical residue, but mostly they have proved unsatisfactory. Soaps alone are not only ineffective, but also dangerous to the fruit. Strong alkalis (caustic soda) may be effective, but readily affect the fruit, as they attack the natural waxes which protect its skin. Sodium metasilicate in 8 per cent. solution shows considerable promise for the removal of residues containing oil, particularly when used in machines with strong agitation. In Victorian trials (1), however, it has not yet shown any superiority to hydrochloric acid, which up to the present has proved the most suitable agent for the removal of arsenic from pome fruits. Hydrochloric acid has its limitations, but as yet there is no solvent or detergent which can be recommended before it.

Hydrochloric Acid.

The use of hydrochloric acid is the same in principle both in machines and troughs. The fruit is immersed in or sprayed with a weak solution of the acid for a short time, allowed to drain, then rinsed in clean water to remove excess acid. The process is reasonably simple, and with the exercise of a little care is quite safe. Strength of acid, time of immersion, nature of residue, and type of fruit are all closely bound up together, but an immersion for two minutes in 3 per cent. acid will remove most residues, and this should be considered as a maximum not to be exceeded unless absolutely necessary. Stronger acid and longer immersions may be used, but additional care must be taken in rinsing the fruit subsequently.

It must be clearly understood that throughout this article per cent. acid means gallons of commercial hydrochloric acid, specific gravity 1.2, per 100 gallons of solution.

For a loose residue of lead arsenate only on a non-waxy apple (e.g., Jonathan), it may be found that immersion in 1 per cent. acid for two to four minutes may be quite effective in removing it, and in such a case the use of the weaker solution is advisable. An oily residue on the same type of apple would require full strength (3 per cent.) acid, and possibly more than two minutes immersion. A waxy or greasy skin on the fruit, such as occurs on Granny Smith and Red Rome apples, will also render the residue difficult to remove, and necessitates stronger acid or longer immersion of the fruit. The residue on russet pears is removed more readily than that on clear-skinned pears. A safe rule is to use the lowest strength of acid and the shortest time of immersion that will give satisfactory removal of the residue as judged by eye, *provided that* each increase in strength of acid or time of immersion is accompanied by a corresponding increase in the care taken in rinsing the fruit. A limit should be placed at 4 per cent. acid and four minutes immersion. Beyond these points it is not only unsafe but also uneconomical to attempt to remove the residue.

As the fruit is passed through the acid, a certain amount of the solution is removed on the fruit and, if they be used, will be absorbed by the cases. This loss must be replaced from time to time with solution of the same strength —e.g., if a 3 per cent. solution is being used, for each kerosene-tin of water added one pint of concentrated acid must be poured into the trough and thoroughly mixed with the remainder of the solution. It should always be remembered that hydrochloric acid is highly corrosive to metals, clothing, and, in the concentrated form, to flesh. Only old clothing should be worn when using acid, and splashing avoided as much as possible. Acid solutions should be retained in earthen or wooden containers only, and the strong acid measured with an earthenware jug or glass measure. Metal containers weaken the acid and soon break up. A supply of bicarbonate of soda (baking soda) should be kept near the acid in case of accidents. Any strong acid splashing on to the hands or face should be immediately washed off with plenty of clean water or a solution of baking soda, the latter particularly when the acid reaches the eyes. Long immersion of the hands in the weak acid solution may make them sore, and they should be washed frequently in the rinse water. They may be protected effectively by slipping the hand and arm into a length of old motor tube of which the lower end has been stuck together by means of rubber solution.

Because of its chemical activity, the strength of the acid solution slowly decreases, especially when the fruit is dipped in cases, the nails in which are readily attacked by the acid. This decrease will be reflected in the non-removal of residue, and this should be used as a guide to the strength of the acid. When normal

residues begin to pass through the acid without being removed, more strong acid should be added without a corresponding amount of water until the solution once more becomes effective. *There is no simple, fool-proof test of the strength of acid which can be recommended for general use.* The safest method is to keep the strength of acid just above the point where it fails to remove the bulk of the residue. The temperature of the solution is important in this regard also, and will be mentioned later under the effects of cool storage on washing.

The acid bath removes from the fruit and any cases immersed in it considerable quantities of dirt and mould spores, as well as the spray residue. The dirt is unimportant, but the mould spores are a limiting factor to the life of the acid bath. There is a gradual accumulation of spores in the solution until it becomes necessary to discard it to avoid increasing the spore load of the fruit and simultaneously the likelihood of mould attack. The generally accepted standard is to change the solution completely after washing 1,000 cases of fruit per 100 gallons of solution. The waste acid should not be run on to land which may be used for growing crops, nor should it be run on to waste ground in the one place too often, as too much may render the soil acid. Grasses seem to thrive on land irrigated with the solution, but it is inadvisable to dispose of it near fruit trees. Under ordinary circumstances there is little danger from the solution, for the acid soon evaporates or combines with soil bases.

The addition of salt to the acid bath has not yet proved of any advantage in Victoria. There is some possibility that the addition of oils or detergents may enhance its value, but this has yet to be investigated more fully, and at present their use cannot be recommended.

A factor of considerable importance with many varieties of apples is the depth to which they are submerged. Pears have no connexion between the seed cavity and the eye, but in certain apples there is a distinct passage, usually known as the "calyx tube," from the eye to the core. The size and clearness of this tube varies with the variety and within the variety—e.g., in Granny Smith apples the calyx tube is invariably closed, while in Delicious 50 per cent. of the fruit will have open tubes and the remainder will have tubes closed, or nearly so. It is very easy for acid under pressure to penetrate such open tubes, and, if an apple with an open calyx tube is submerged more than 6 inches in the solution, core penetration is almost certain to result. Once inside the apple the acid cannot escape. It attacks the surrounding flesh and stimulates mould growth to such an extent that within a few weeks the whole apple is rotten. Figure I. depicts typical examples of rot following core penetration. In an experiment on this factor, Five Crown apples submerged to 6 inches developed 9.2 per cent. rot, while similar apples submerged to 12 inches developed 32.3 per cent. rot. The figure of 9.2 per cent., as explained later, was reduced to 1.4 per cent. by rinsing in limewater. It is exceedingly important, therefore, that varieties of apples having open calyx tubes should not be submerged more than 6 inches below the surface at any time during the washing process. Varieties known to be particularly susceptible are Delicious, Five Crown, and Cleopatra. Until other varieties have been investigated, it will be advisable to avoid deep submersion for all apples.

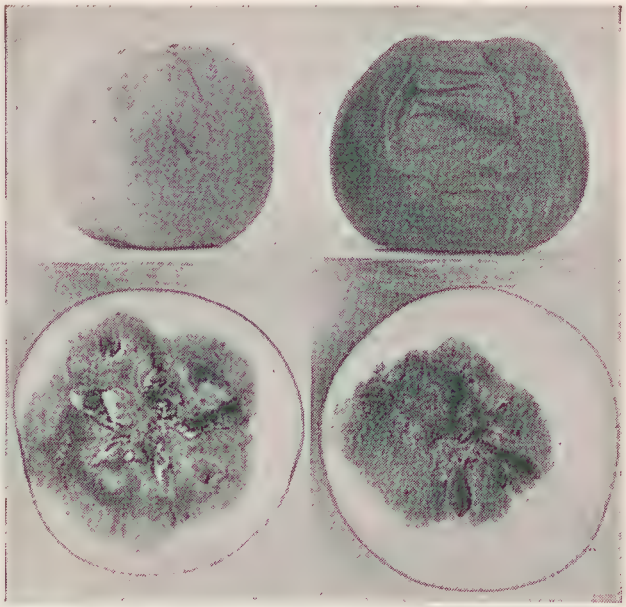


Fig. 1.—Five Crown (left) and Delicious apples with typical rot following core penetration by acid owing to deep immersion.

Rinsing the Fruit.

Upon removal from the acid bath the fruit is drained for a short time, then transferred to the rinse bath. This should consist of a volume of water at least equal to that of the acid bath, and should be slowly and constantly changing. This is accomplished best by a slow stream of water flowing into the end of the trough opposite to that at which the overflow pipe is situated. The fruit should be thoroughly swilled in this water; then upon removal should be given a final spray or douche with clean water. The water used in this final rinse may conveniently supply the slow stream of water flowing into the rinse bath to keep it fresh.

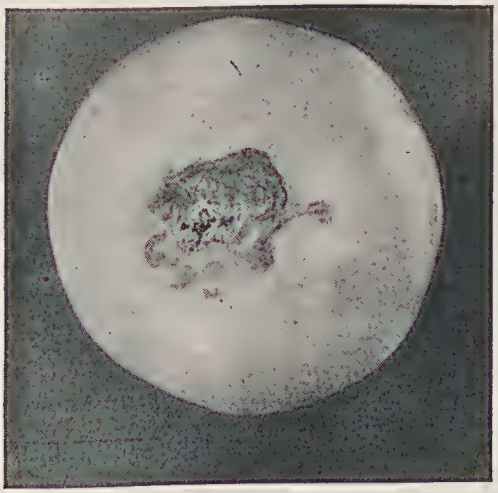


Fig. 2.—Apple showing calyx injury following inadequate rinsing after acid treatment.

It is essential that the fruit be tested at regular intervals to make sure that it is being rinsed sufficiently. The test is simple and reliable, and consists of applying the tip of the tongue to the calyx of the fruit—a stinging sensation or a slight acid taste indicates that more rinsing is required. Several fruits should be tested each time. If fruits inadequately rinsed are stored, calyx injury is likely to develop and render the fruit unsaleable. (See Figure 2.)

After rinsing the fruit may be stacked in cases to await removal to the cool store, or may be packed immediately. There is no necessity for the fruit to be thoroughly dry before packing or storing, as the moisture evaporates almost as readily in store as it does in the open air.

Machine Washing.

Machines so far placed on the Victorian market are large and expensive, and are suitable only for large growers or packing sheds. While as yet they have a few mechanical defects which may cause injury to certain types of fruit (e.g., Beurre Bosc pears), they are generally satisfactory in the removal of residues, and work on sound principles. The fruit is protected from deep immersion, and the strong agitation of the solutions gives thorough washing and rinsing. They are naturally confined to areas where an abundant water supply is available.

Hand Washing.

This is the commonest method of washing fruit employed in Victoria at the present time, and calls for special considerations in addition to those which apply to any acid wash. Hand washing is carried out in troughs, which may vary from half-barrels, capable of taking one case at a time, up to long wooden troughs which will take fifteen cases at once. A convenient-sized trough is one to take three dump cases simultaneously (see Figure 3). Two troughs are required, and they are best constructed of kauri. They must be well braced, and any metal parts used in their construction must be of copper or bronze. The complete plant specified in Figure 3 should not cost more than £20.

The fruit is almost invariably washed in cases. Pears and apples having a definitely closed calyx tube may be washed in dump or kerosene cases, provided that there is sufficient spacing between the boards to allow free movement and drainage of the acid solution and rinsing water. Kerosene cases are usually too tight for this purpose, but the removal of a half-inch strip from one edge of each board will make them quite suitable without spoiling the cases for other purposes. Fruit to be washed should not be placed in papered cases, or if papering is regarded as essential to successful storage, as in some varieties of pears, it should be transferred to unpapered cases for washing. Paper will stop free movement and adequate drainage of the solutions, and in addition will absorb a certain amount of acid which rinsing will not remove. Fruits in contact with the paper subsequently will suffer from acid burn.

Apples in which the calyx tube is open must not be washed in dump cases, as some of the fruit would have to be submerged at least 10 inches to allow all the fruit to be washed.

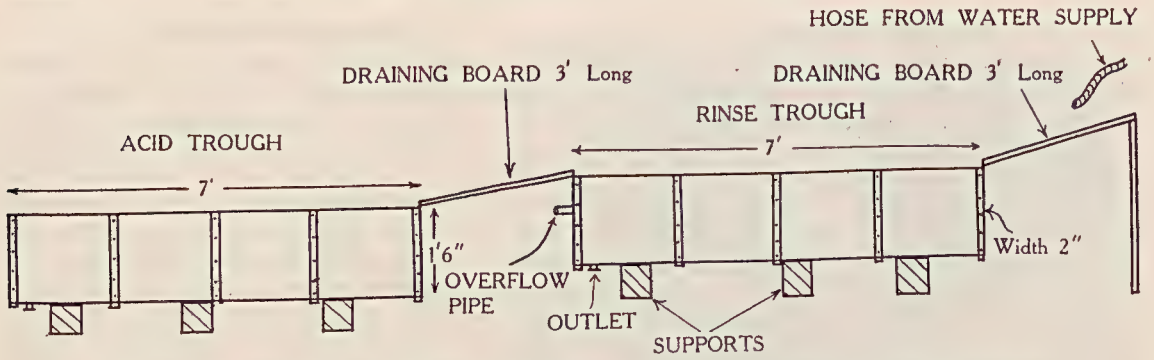


Fig. 3.—A suitable type of trough designed to take three dump cases simultaneously.

They must be picked or transferred into flat cases, such as the long bushel, opened on one side, and carefully washed in these. After washing in acid they should be dipped in a bath of limewater (10 lb. slaked lime per 100 gallons water) instead of the usual water bath, and preferably submerged to a depth of 1 foot. A light rinsing with running water will serve to remove any excess lime on the surface of the fruit. An experiment conducted with Five Crown apples (1) showed that with fruit submerged no more than 6 inches in the acid bath, this limewater treatment reduced the rot resulting from core penetration from 9.2 per cent. to 1.4 per cent. Fruit submerged to 12 inches in the acid bath and rinsed in water developed 32.3 per cent. core rot, which was reduced only to 28.3 per cent. by dipping in limewater. The use of limewater alone is not sufficient to protect the fruit. It is the depth of immersion in the acid bath which is of primary importance.

It is best to have a number of loose lids to fit the type of case in use. These may be lightly nailed to each case for washing, or affixed in some other temporary manner. A separate lid for each case is desirable, so that each may be moved separately in the acid and rinse troughs. Pears can sometimes be washed in unlidded cases, but apples are lighter than water and would float out.

Rinsing in clean water requires care in troughs. Each case should be constantly moved, and lifted right out of the water two or three times before being placed on the draining board for a final rinse with running water from a hose. One or two gallons of water is sufficient for each case of fruit. Every orchardist who has sufficient water for spraying can have running water at the troughs for rinsing. The spray cart can be filled at the supply, and brought up to the troughs. By removing the nozzle from one of the rods, slipping on to it a short piece of ½-inch hose or rubber tubing, and running the pump at slow speed with the by-pass fully open, a stream of water suitable for rinsing is readily obtained. An 80-gallon vat should last for an hour or more. If necessary, the stream can be stopped between the rinsing of successive cases by means of the tap on the spray rod. Should there be insufficient water, however, for even this method of keeping fresh water in the rinsing trough, the same water may be used for some time if a few pounds of hydrated lime are added to prevent the accumulation of acid. The life of such a rinse bath is limited by the same factor as the acid bath—the accumulation of mould spores—and it should be completely changed at the same time as the acid bath.

A definite routine can be developed which will give maximum output with the troughs. One man is stationed permanently at each trough, and a third man attends to the supply and removal of fruit. Suppose three-case troughs are in use. The first case is immersed in the acid, swilled about for a short time, then pushed towards the other end of the trough. The second case is treated likewise; then the third is introduced, swilled, and left in position. The time taken over each case should be one-third of the total time which each is to be in the acid. The first case is then lifted on to the draining board, the two remaining in the trough pushed along, and a fourth case introduced and plunged up and down. The second case is then transferred to the draining board, the man at the rinsing trough at the same time removing the first case. This cycle is kept going in the acid and rinsing troughs, except that the man rinsing the fruit will have to find time to use the hose as well as rinse the fruit in the trough.

When to Wash.

It is advisable to wash the fruit as soon after picking as is possible for several reasons:—

Firstly, the residue at picking time is as easy to remove as it will ever be. During storage the fruit will increase the amount of wax on its surface, and this wax will protect the residue from the action of an acid solution. It is far more difficult to remove residue from stored fruit than from freshly-picked fruit.

Secondly, it reduces handling costs. Picking can be carried on and the fruit placed in a shady spot near the troughs until sufficient has been accumulated to make a day's washing. It can then be washed and taken to the store for packing and storage. If this is not done, the fruit must be placed in store, then taken out again, transported to the troughs, and replaced in store.

Thirdly, fruit taken from the store and washed reduces the temperature of the acid bath to such an extent that it becomes ineffective. This may be overcome by replenishing the acid with warm water, but the temperature of the bath should not rise above 80° F., as serious acid injury may result from higher temperatures. It must be remembered, however, that this sudden raising of the temperature of the fruit, and subsequent lowering of it, may quite easily affect its storage life.

Comparative Costs.

A comparison of the costs of wiping and washing shows a balance very much in favour of the washing. An approximate estimate of the costs is as follows:—

Wiping.—One man can wipe 50 cases per day; i.e., it costs 12s. to wipe 50 cases, or 2.88d. per case.

Washing.—Take a low estimate of 40 cases per hour, or 320 per day—

	£	s.	d.
Labour, three men at 12s. ..	1	16	0
Acid, 2 gallons	0	5	0
Water, 1,000 gallons (maximum)	0	1	0
Allow depreciation, &c. ..	0	10	0
Total	£2	12	0

I.e., cost is 1.95d. per case. This is almost 1d. per case less than hand wiping.

Washing in troughs is undoubtedly the cheapest and most effective method of reducing the amount of arsenical residue on fruit below the tolerance, and, provided the necessary precautions are taken, damage to the fruit is practically nil.

Summary.

1. When there is a heavy residue on the fruit, avoid late oil sprays.

2. Wash fruit rather than wipe it. Washing is quicker, more effective, and cheaper.

3. A good standard wash is immersion for two minutes in 3 per cent. hydrochloric acid, but this may be varied according to conditions.

4. Wash fruit immediately after picking.

5. Keep the volume and the strength of the acid up. Change the acid completely after washing 1,000 cases per 100 gallons of solution.

6. Use free-draining cases for washing.

7. Submerge pears to any depth, but keep apples within 6 inches of the surface.

8. Rinse thoroughly and test the fruit for acid regularly.

9. Use constantly-changing water for rinsing where possible. If unable to do so, add lime to the rinse bath, and change it at the same time as the acid. Also use a lime bath for apples having open calyx tubes.

10. Drying the fruit is unnecessary—it can be stored or packed immediately.

Reference.

(i) Full details of experiments on residue removal carried out by the Victorian Department of Agriculture during 1934 and 1935 will be published at a later date. The figures quoted in this article are taken from these experiments.

Book Received

Farm Irrigation (Rocla Ltd.).—A useful handbook containing a good deal of helpful information and advice for the irrigation farmer. In addition to many valuable tables, this handbook contains a summary of methods of irrigating all the principal crops usually grown under irrigation. The preparation of the land before watering, drainage, and the installation of pumping plants are dealt with. This booklet is obtainable free on application to Rocla Ltd., 99 Queen-street, Melbourne, C.1.

Numurkah Crop Competition, 1935

Report of the Judge—J. A. Morrow, B.Agr.Sc., Cereal Experimentalist

UNUSUAL weather conditions during the fallow period had caused some modifications in the cultivation of the soil for the 1935 crops, but, fortunately, the conditions which prevailed throughout the growing period were practically ideal for wheat growing. On the average, the crops were better than had been obtained for many years, some being estimated to yield more than 12 bags per acre.

Ample rains were received at suitable intervals, enabling the growth of the crops to continue unchecked and without causing any outbreak of rust, which was responsible for heavy losses in an otherwise favorable season last year. Apart from a little flag smut in some varieties, and a few patches of take-all, disease was present in only very small amounts.

The weed growth consisted almost entirely of wild oats, and it is interesting to note that these were practically absent from most of the competition crops, but were present in large quantities in many of the district crops not entered in the competition. This weed is difficult to eradicate completely on account of its early shedding, and its capacity to remain as seed in the ground for long periods without germinating. A fairly effective control can be obtained by the adoption of a modification of the "summer fallow" principle. A light discing of the stubble after the burn would produce conditions favorable for a greater germination of wild oats and other weeds, which could then be fed off and buried at the normal fallowing time. Seeding in the fallow should be prevented by the use of sheep and the scarifier. In places where conditions permit, it would also be advisable to induce an extra wild oat germination and kill before proceeding with the seeding. This would involve an extra cultivation, and would possibly delay seeding for a week or so. The continued application of these methods for a few years should cause a material decrease in the wild oat infestation.

Of the varieties of wheat sown in the district, Ghurka occupies the largest area, having rapidly taken the place of Free Gallipoli. Ghurka is capable of producing high yields under most conditions, and in addition is highly resistant to flag smut—an important point in its favour for a district where there is a considerable annual loss from this disease amongst susceptible varieties. Its shortness of straw makes it better able to withstand storms and dry conditions, but makes the variety unsuitable for use in paddocks where tall-growing weeds are bad.

Ghurka is a late maturing variety, and is not so suitable for conditions which require a delayed seeding for weed control. In cases where the fallow is not clean, or early seeding cannot be carried out, the variety Ranee 4H generally will prove more satisfactory.

Some of the competitors were concerned because of the number of "strange" heads which appeared in their Ghurka crops. Ghurka is a complex crossbred, and the appearance of strange heads may be due to the fact that natural crossing in the field sometimes takes place, or that the wheat is throwing back to one or other of its parents. The cerealists of the Department of Agriculture are working to overcome this factor (which apparently does not lower the yield), and continuous selection is going on to ensure that a pure strain reaches the farmer. Wheat growers should endeavour to obtain a bag or so of the latest selection each year in order to build up the farm bulk seed supplies.

A feature of the season's cropping was the greatly increased area sown to the New South Wales variety, Dundee. This wheat is very popular in New South Wales, and some very fine crops were seen in the Numurkah district this year. The grain produced was of excellent appearance, and high yields will be obtained. This variety grows a little taller than Ranee 4H, and is somewhat liable to lodge should bad weather be encountered.

There are indications that a further increase in the area sown to Dundee will occur next season, but it would be desirable for farmers to content themselves with small areas of new varieties until definite evidence from accurately conducted experiments prove that, over a number of years, the new variety will give greater

returns than the variety in general use. Dundee has been sown in the Department of Agriculture's experimental plots on the farm of Mr. W. White, at Invergordon, and growers would be well advised to keep themselves conversant with the results obtained, and not to adopt any wholesale changes until the tests have been carried out for at least three or four years.

The variety Dundee, like Ranee 4H, showed a fair amount of flag smut, but in neither case was the infection as bad as that which occurred in the Free Gallipoli crops exhibited.

Feeding-off the wheat crop with sheep is practised fairly generally, and in this season it does not appear to have had any detrimental effect. Light feeding-off, in addition to providing a certain amount of winter feed, checks rank or strong early growth, and so tends to minimize the risk of subsequent lodging, but great caution should be exercised to ensure that feeding-off is not practised too late in the season, or when there is a danger of unpalatable weeds gaining an advantage over the checked wheat crop.

In the Numurkah district, the wheat crops usually are grown in a wheat-oats-fallow rotation, which is very desirable both from the point of view of increased returns per acre and for disease control. The disease flag smut is prevalent in this district, and its incidence was probably increased by the widespread use of susceptible varieties, such as Free Gallipoli. With the decline in the area sown to Free Gallipoli, and the increase in the seedings of Ghurka, a reduction in the losses from this disease can be confidently expected. Oats are immune to flag smut, and the rotation mentioned is helpful in keeping the disease within reasonable limits. Where the area is known to be badly infested with flag smut, it would be desirable to take off a crop or two of Ghurka prior to using a susceptible variety.

In some of the crops, patches of take-all were noticed. The term take-all usually includes the various forms of foot-rot as well as the true take-all, *Ophiobolus graminis*. The usual symptoms in the form of "deadheads," &c., are found, and the principal methods of control can be applied to all types. To check this type of disease it is necessary to keep the fallow in a clean, well-worked condition. Working the fallow produces conditions favorable for the germination and ultimate death of the spores of the disease. Dry cultivation, however, tends to distribute the disease rather than check it. Some of the grasses commonly found on fallowed ground can carry the disease, and it is therefore necessary to check these by cultivation. This involves a loss of some of the grazing value of the fallow, but is worth while in conditions of severe take-all infection. No variety is known to be resistant.

The most common application of superphosphate in the competition crops was about 70 lb. per acre. Results from experimental plots at Waaia indicate that, with the price of wheat as low as 2s. 6d. per bushel, the manurial dressing could be increased profitably to at least 1 cwt. per acre.

The winning entry was a crop of Ghurka exhibited by Mr. J. Mortimer, of Katunga. The crop was somewhat taller than is usual with this variety, and was remarkably dense and uniform throughout. Very few wild oats were present, and these were the only weeds noticed. In one or two small areas some take-all was seen, but the amount present was insignificant. Apart from the few "off-type" heads characteristic of the variety, the crop was very pure, very few real "strangers" being present. In some of the crops of this variety, particularly those which matured earlier, considerable pinching of the grain had occurred, possibly as a result of frost. In the winning crop, in common with others which matured later, there was no evidence of pinching, the grain being well filled and of attractive appearance.

The ground on which this crop was grown was comparatively new, having been under cultivation for only five years. It was ploughed early in July, and harrowed immediately. It was cultivated in September, and disc-cultivated in October. It was again cultivated in April, and sown with a combine during the second week in May, 60 lb. per acre of both seed and superphosphate being used.

The second crop, also Ghurka, was grown by Mr. W. Hodge, at Invergordon. This also was a very good even crop, free from weeds and disease, but not quite so dense as the winning crop. For purity of type and quality of the grain sample, this crop was comparable with that exhibited by Mr. Mortimer. The paddock was ploughed in June, and harrowed after the plough. It was cultivated with the combine in October and January, and sown with the combine in the first week in May. It was harrowed lightly after the combine. Seeding was at the rate of 65 lb. with 1 cwt. of superphosphate per acre.

Third placing was shared by four competitors, each of which exhibited a very fine crop. Mr. E. C. Watters' crop of Dundee was tall, dense, and very well headed, and a high yield of excellent quality grain was indicated. A trace of flag smut and a few wild oats were present. The paddock was ploughed in July, and harrowed. It was cultivated with a spring-tyned implement in October, and received no further treatment except grazing until early May, when it was sown with a combine followed by light harrows, 60 lb. of seed and 93 lb. of superphosphate per acre being used.

Jeffery Brothers' crop, also of Dundee, was a shade taller than that shown by Mr. Watters, but otherwise closely resembled it. A very small amount of lodging occurred in each. The ground for this crop was ploughed in July, and harrowed. It was cultivated with a combine at the end of July, in September, and again in March. It was sown with the combine at the end of April, using 65 lb. of seed and 70 lb. of superphosphate per acre.

Mr. W. White, of Invergordon, showed a very nice crop of Free Gallipoli. The crop was free from "strangers," and very few weeds were present. A fair amount of flag smut was noticed, and some lodging had taken place in small areas. The ground was ploughed in early August, and harrowed after the plough. It was cultivated in October and early April with a rigid-tyned implement, and was sown with a combine in May, using 60lb. of seed and 100 lb. of superphosphate per acre.

Lukies Bros'. entry of Ranee 4H was a very clean crop, free from strangers and weeds. A little flag smut was present, and the crop was not quite so even as the winning crop. A little lodging had taken place in the lower portions of the paddock where water had collected following a heavy storm. The paddock was ploughed at the end of June, harrowed twice in September, Wimmera scarified in October and the end of March, and sown with a combine in early May. It was harrowed after the combine. Seeding was at the rate of 60 lb. with 70 lb. of superphosphate per acre.

Many of the remaining crops in the competition were also of a very high standard, and missed a place by only a slight margin.

The detailed points allotted are given in the accompanying table.

Competitor.	——	Variety.	Yield.	Purity and Type.	Evenness.	Freedom from Weeds.	Freedom from Disease.	Total.
Possible Points ..	.. ..		**35**	**20**	**15**	**15**	**15**	**100**
J. Mortimer ..	Katunga ..	Ghurka	35	18	15	14	14	96
W. Hodge ..	Invergordon ..	Ghurka	34	18	14	14	14	94
E. C. Watters ..	Tallygaroopna	Dundee	33	19	14	13	14	93
R. Jeffery ..	Wunghnu ..	Dundee	33	19	14	13	14	93
W. White ..	Invergordon ..	Free Gallipoli ..	33	19	14	14	13	93
Lukies Bros. ..	Katamatite ..	Ranee 4H ..	32	19	14	14	14	93
N. Cowan ..	Numurkah ..	Dundee and Ghurka	31	19	14	14	14	92
Lukies Bros. ..	Katamatite ..	Dundee	31	19	14	14	14	92
I. Ross ..	Kaarimba ..	Ghurka	29	19	13	14	14	89
D. Rendall ..	Baulkamaugh..	Ghurka	30	18	14	14	13	89
H. Formby ..	Tallygaroopna	Ghurka	29	18	14	14	14	89
R. Adams ..	Katunga ..	Free Gallipoli and Bobin	29	19	13	14	13	88
D. Tweddle ..	Yarroweyah ..	Ghurka	27	18	14	15	14	88
A. Tweddle ..	Waaia ..	Ghurka and C.M.G...	29	18	14	13	14	88
L. Biggar ..	Waaia ..	Ghurka	29	17	14	13	14	87
W. Moss ..	Kaarimba ..	Ghurka	28	18	13	13	14	86
R. Bunnett ..	Naring ..	Dundee	26	18	14	14	14	86
J. Mortimer ..	Katunga ..	Dundee, Baldmin, and Ranee 4H	27	18	13	13	14	85
P. Tweddle ..	Waaia ..	Ghurka	26	18	14	13	14	85
Lukies Bros. ..	Katamatite ..	Ghurka	26	18	13	14	14	85
S. Hendy ..	Naring ..	Dundee	26	18	13	13	14	84
W. H. Tyack ..	Numurkah ..	Ranee 4H ..	26	19	13	13	13	84

NOTE.—The points allotted for yield are for comparative purposes only and do not represent the estimated yield in bushels per acre, a number of the crops having been estimated to yield more than twelve bags per acre.

Blackleg in Cattle

By N. Sjögren, B.V.Sc., Veterinary Officer

BLACKLEG is an acute infectious disease of cattle caused by a specific organism (*Clostridium chauvoei*). Cattle between the ages of four and eighteen months are the most susceptible, and, like some other bacterial diseases, blackleg principally attacks animals in the best condition.

Method of Infection.

The blackleg bacillus is an anaerobe, that is, it will not grow in the presence of oxygen, hence it is found only in the deep-seated tissues of the diseased animal. It is a spore-bearing germ, and the spores are very resistant to extremes of temperature and also to chemical agents. These spores contaminate the soil, and may remain viable for years. Swamps, low-lying pastures and muddy areas, in which spores may accumulate in great numbers, are particularly dangerous.

Infection results from the ingestion of feed or drinking water contaminated with blackleg spores, which may gain entrance to the animal's body through small wounds such as those caused by thorns and sharp sticks, more particularly if they are in the region of the mouth. Pastures growing on areas where carcasses of cattle infected with blackleg have previously been buried are particularly dangerous. The fact that a succession of outbreaks have occurred on properties watered by the same stream indicates that the disease may be water-borne.

Symptoms.

In many cases no symptons are noticed as the animals usually are found dead. When symptoms are observed, animals show a high temperature, loss of appetite, suspended rumination, and lameness in one or more legs. A characteristic swelling generally appears where the muscles are bulky, such as the loin, shoulders, thigh, chest, or neck. This swelling which is of irregular shape, is at first hot and painful, but soon becomes cold and insensitive. The skin over it becomes hard and dry, and there is often a line of demarcation between the diseased and healthy tissue.

On passing the hand over the swelling, a peculiar crackling sound like the rustling of paper is heard. This is due to the presence of gas in the swelling, the gas being formed in the tissues by the bacillus causing the disease. In some cases, where the lesion occurs in the deep-seated muscles, no external swelling is observed. The frequent occurrence of the swelling in the upper part of a limb has given to the disease the name of blackleg or black quarter, and it is this distension which causes the lameness.

The duration of illness is from 12 to 48 hours. The symptoms develop rapidly, with increasing weakness, rapid breathing, high temperature, and convulsions. It is most exceptional for an animal to recover from the disease.

Post-mortem Appearances.

The characteristic post-mortem finding is the crackling swelling already mentioned. On removing the skin over the swelling, the muscle is found to be darker than usual, in some cases quite black, and infiltrated with gas bubbles, and gives off a characteristic odour, resembling rancid butter. The muscle is drier than normal, and the formation of gas results in the separation of the muscle fibres. A reddish fluid exudes when the muscle is cut.

In the abdomen and chest cavity there is often blood-stained fluid. The membrane of the intestine may be blood-stained, and the liver congested and mottled.

Diagnosis.

Sudden deaths among young cattle, associated with lameness and characteristic crackling swellings in the muscles of the limbs, should cause farmers to suspect blackleg. In suspicious cases, in order that the diagnosis may be confirmed, a portion of the affected muscle—about 2 inches in diameter—should be placed in a screw-top glass jar, and forwarded to the Director, Veterinary Research Institute, Parkville, N.2. A letter advising the despatch of the material for diagnosis should be forwarded at the same time.

Prevention.

Treatment is useless. Any incisions of the swellings are likely to perpetuate the disease by distributing the germs about the pastures and premises. Prevention consists of avoiding affected pastures, and destroying (by burning) carcasses of animals which have died from the disease. The non-destruction of carcasses is one of the most potent factors in spreading the disease. Killing and properly disposing of animals in which the disease is definitely diagnosed, burning off infected pastures, and the vaccination of animals on infected properties are essential precautionary measures.

Vaccination.

The only effective method of preventing the disease is by vaccinating calves before they reach the susceptible age, and the Commonwealth Serum Laboratories prepare a vaccine which is recommended for this purpose. It contains no living organisms, therefore it is quite safe, and it confers an immunity which persists during the susceptible period. A permit to obtain the vaccine will be supplied on application to the stock inspector of the district, and the inoculation, which consists of the injection of the vaccine (under the skin) can be carried out by the farmer himself. The usual precaution of clipping the hair and sterilizing the skin with tincture of iodine or methylated spirits before injection should be observed. The inoculation is made usually behind the shoulder. A suitable hypodermic syringe and needle is all that is required, and this with care will last for years, so that the only expense each year is the cost of the vaccine itself.

Some blackleg vaccines contain living organisms of the disease, and their use may be the means of introducing the disease on to clean properties. Furthermore, a live vaccine may, under certain conditions, cause the death of a susceptible animal, and in some districts the rapid spread of the disease has been attributed to the indiscriminate use of live vaccines. On this account, permits to use a live vaccine will not be issued unless the disease has been definitely diagnosed on the property.

The Department of Agriculture strongly recommends the use of the Commonwealth Serum Laboratories' vaccine for the prevention of blackleg.

As blackleg is a notifiable disease under the Stock Diseases Act, all outbreaks should be reported to the Chief Veterinary Inspector, Department of Agriculture, Melbourne, C.2.

Blue Mould in Tobacco.

(*Continued from page* 21.)

to 7,000 seedlings per day. Pricking out costs, therefore, should not exceed 2s. per 1,000. As pricking out is not carried out until relatively late in the season, weeding practically is eliminated. The cost of pricking out, therefore, would be somewhat offset by the elimination of weeding costs.

The main glass-house trouble experienced is "damping off," and in the open seed beds, after pricking out, the greatest trouble arises from attacks by slugs.

It did not seem possible to obtain any definite estimate as to the cost of growing seedlings, as in the districts visited there was no contract growing of seedlings. It is estimated, however, that it should be possible to raise seedlings to the "lifting stage" for from 12s. 6d. to 15s. per 1,000.

The cost of lifting seedlings would approximate 2s. 6d. per 1,000, the cost of casing 1s. per 1,000, and transport costs to boat 1s. per 1,000. Assuming 15s. per 1,000 as the cost of growing, the total charges in New Zealand would then amount to 19s. 6d. per 1,000. Add to this a transport charge of 5s per 1,000, and the landed cost in Wangaratta should be 24s. 6d. per 1,000.

In concluding this interim report, it is desired to acknowledge particularly the very courteous and helpful treatment rendered by the quarantine and Customs officials in Sydney, and by the whole of the departmental officers contacted in New Zealand, especially Messrs. Campbell, Scott, Lowe, and Dallas.

A further report, discussing the progress in the field of the seedlings, will be furnished when it is possible to assess more accurately the effect of such long transport on the ultimate growth of the plants. At this stage, having regard to the nature of the seedlings handled, the "strike" and growth up to date at Myrtleford have been very satisfactory.

Imperial Economic Committee

AN important reorganization of the constitution and work of the Imperial Economic Committee is described in a report which that body has recently issued.* Though intended to be the first of a series of annual reports on the committee's work, this report actually covers a period of eighteen months, during which the Honorable G. H. Ferguson, High Commissioner for Canada, has been chairman.

The Imperial Economic Committee was established ten years ago, as a result of decisions reached by governments following discussions at the Imperial Conference of 1923. Successive Imperial Conferences amended its constitution and widened its functions. Early in 1933 its constitution and functions were again surveyed by the Imperial Committee on Economic Consultation and Co-operation which met in London in pursuance of a resolution adopted at the Ottawa Conference. In April, 1933, this investigating committee presented its report, in which emphasis was laid on the need for Imperial co-operation, both in regard to scientific investigation and economic inquiry, and a further point made that the existence of national intelligence services and agencies for market promotion did not imply that there were not branches in the field of market intelligence and market promotion in which co-operative action between the peoples of the Commonwealth was desirable. No attempt was made to define in detail, or for all time, the field of co-operation in economic inquiry. Instead, the committee preferred—

(*a*) to select from the activities which came under its examination those which, in its opinion, should forthwith be continued on a co-operative basis;

(*b*) to provide power for the addition of new services and new activities on a co-operative basis as occasion needed, and as governments from time to time should agree;

(*c*) to establish the practice of financial co-operation in all such work;

(*d*) to ensure observance of the principle of "equality of status" in the control of that work;

(*e*) to provide for "the careful and periodical examination at Empire conferences, suitable for the purpose," of inter-Imperial activities conducted and organized co-operatively.

The Committee went on to consider the work and organization of the Imperial Economic Committee, and the statistical marketing intelligence and economic investigations conducted by the Empire Marketing Board, and finally recommended that the Imperial Economic Committee, while continuing to discharge its former functions, should take over from the Empire Marketing Board the preparation and issue of periodical market intelligence notes and world surveys of production and trade, and that it should be within the competence of the Imperial Economic Committee to make proposals to governments in regard to other economic services and inquiries which in its view should be conducted on a co-operative basis.

The recommendations were accepted by all governments, and the Imperial Economic Committee was reconstituted with effect from the 1st October, 1933. The Committee then ceased to be the responsibility of His Majesty's Government in the United Kingdom and became the responsibility of the British Commonwealth of Nations. The composition of the Committee, and the number of representatives of each part of the Empire, are determined by agreement among the several governments, on a basis of constitutional equality. The several members of the Committee are each appointed by their own governments. Reports are addressed to all the governments of the Empire. Finance is provided by all governments in agreed proportions, and the resulting fund is controlled, not by any one government, but by all the governments, acting through their representatives on the Committee.

The staff, now directly appointed and controlled by the Committee, includes a notable proportion of officers either born in the Empire overseas or possessing overseas experience. The reorganization necessarily tended to slow down work at first, but during the period reviewed the Committee issued to the governments of the Empire two reports after formal inquiry, one on Grassland Seeds, and one on Maize, and two World Surveys, one on Cattle and Beef, and one on Ground Nut Products. It was also engaged on two Trade Surveys, on the Motor Car, and Electrical Industries, and on a World Survey on Sheep, Mutton, and Lamb.

* Imperial Economic Committee: Annual report covering the period, 1st October, 1933, to 31st March, 1935.

(*Continued on page* 55.)

"Halo Blight" in French Beans

A Report on Measures for its Control

By D. B. Adam, B.Agr.Sc., formerly Plant Pathologist

The research work reported below was carried out at Burnley and Orbost under the direction of Mr. Adam while he occupied the position of Plant Pathologist of this Department. More recently work on this problem has been confined to the development of varieties showing resistance to the disease, and very promising results have been obtained. An account of these more recent experiments will be published at a later date.

DURING the bean growing season of 1930-31, a bacterial disease first assumed such proportions as to cause concern among Victorian seed bean growers. An investigation of the problem revealed the fact that the organism causing this disease was a bacterium that had been described in the U.S.A. about four years previously, and had been named *Phytomonas medicaginis* var. *phaseolicola* by W. H. Burkholder (1).

In this report it is not necessary to recapitulate the measures taken to establish this identity nor to describe the steps by which it was proven that this bacterium does actually cause "halo blight" in beans. Furthermore, it is not intended to review the vast amount of information now published in regard to this disease, but only to touch upon such features of its life history as are required to understand the bearing that the measures described below have upon the problem of the control of this disease.

Probably the most important feature of "halo blight" is the fact that a diseased plant may produce seed which is infected. This point, first established by American workers, has been amply confirmed by the work of investigators in other countries and by ourselves. A proportion of these infected seeds when planted produce infected plants, and these serve as centres from which the disease may spread during the growing season. Although it is difficult to distinguish between plants diseased as the result of being grown from infected seed and plants grown from healthy seed and infected subsequently, it is considered that the proportion of the former infections, while it varies with different seed samples, is seldom more than a small percentage of all the plants in the field. In other words, while the planting of diseased seed ensures the presence of the disease in a field, it is principally the extent of its spread during the growing season that determines the amount of damage caused by it. The extent to which the disease spreads in the field is dependent on the presence of moisture. In this connexion, rainfall in its various aspects is paramount, though dew also is probably of some importance.

For the growth of a field crop such as beans we cannot, of course, influence the weather features which provide favorable conditions for the spread of the disease, although, as will be shown later, varying the time of planting means that the plants in their various stages of growth will be exposed to different weather conditions, and this may have a bearing on the spread of the disease.

A second source from which the disease may arise each season is the debris of a previous crop. At Orbost, which is the principal centre of the bean seed growing industry, beans are usually grown in rotation with maize, though it is not unusual to grow two crops of beans in succession before returning to maize growing. In view of this practice, every opportunity was taken to look for differences in the extent of infection in fields growing their first or second bean crops, and especially for cases where seed from the same sample had been used to plant these two types of fields at substantially the same time. The observations, which consisted in making counts of diseased plants in these fields, revealed no substantial difference that could be attributed to the immediate past crop history of the field.

There is, however, one sort of practice where the debris of a previous crop may be observed to enhance the infection of the succeeding crop. This is the case where a crop, on account of its being badly diseased, is ploughed in, and the ground is planted with beans again almost

immediately. The enhanced infection resulting from this practice is shown in an increase in the number of infected seedlings, though such an increase in the numbers of diseased seedlings does not necessarily lead to a badly damaged crop, a point which may be illustrated by reference to a particular case. A badly diseased crop had been ploughed in, and the ground replanted with seed from the same stock as was used originally. In the second crop, a count of diseased seedlings made a fortnight after planting revealed about twice as many diseased seedlings as was found at the same stage of development of the first crop, and yet the second crop, as it was subject to less favorable conditions for the spread of the disease, yielded fairly good results.

There is no evidence to suggest that the organism causing "halo blight" can infect maize or any of the other cultivated plants or weeds that grow on the Orbost flats, so that they do not appear to be of importance in the maintenance, spread, or carry-over of the disease. Bearing in mind the importance of seed infection as a means of introducing the bacterium to a crop and the influence of weather conditions on its subsequent spread, it is now possible to indicate the lines along which the investigations have been pursued. These may be grouped under the following headings:—

(1) Observations on the spread of the disease each season.

A study of the effect of varying the date of planting on "halo blight" development, together with observations on the spread of the disease each year.

(2) Measures aimed at the production of disease-free plants, and hence of disease-free seed.

(3) The disinfection of infected seed.

(4) A study of the comparative resistance to "halo blight" of certain bean varieties, and especially of different selections of the "Canadian Wonder."

1.—The Effect of Varying the Date of Planting on Disease Development.

Beans when grown for seed purposes on the Orbost flats are seldom planted before November or after the end of December. The bulk of the planting is done in the last three weeks of November and the first week of December.

In studying the effect of time of planting over the three seasons 1931-32—1933-34, the following procedure was adopted. At regular intervals in the season, plantings were made in small plots, approximately 1-12th acre in area. Each season the seed used in each plot was drawn from the same sample and planted on land that had previously grown maize.

To measure the effect of different times of planting, counts were made of healthy and diseased plants at different intervals after planting. The figures given in Table I. show what percentage of the total number of plants was affected with "halo blight" in these plots.

TABLE I.—PERCENTAGES OF PLANTS AFFECTED WITH "HALO BLIGHT" IN THE TIME OF PLANTING PLOTS.

(*a*) 1931-32.

Date of Planting.	Period After Planting. 6 weeks.	12 weeks.
	Per cent.	Per cent.
November 1st ..	.. 100	.. —
November 18th	.. 12	.. 24
December 8th ..	.. 2	.. 10

(*b*) 1932-33.

Date of Planting.	Period After Planting. 6 weeks.	8 weeks.	10 weeks.
	Per cent.	Per cent.	Per cent.
November 10th ..	9 ..	100 ..	—
November 29th ..	18 ..	49 ..	100
December 10th ..	12 ..	* ..	100

* No count made.

(c) 1933-34.

Date of Planting.	Period after Planting. Three Weeks.	Four Weeks.	Five Weeks.	Six Weeks.	Seven Weeks.
	%	%	%	%	%
November 7th ..	7	..	22	..	100
„ 14th ..	..	17	..	100	..
„ 21st ..	7	..	100	..	..
„ 28th ..	..	100	..	..	..
December 7th ..	7	*	..	..	..

* Later counts could not be made as all plots were destroyed by a flood in January.

The above figures refer only to the numbers of diseased plants, and give no indication as to the severity of the disease. On this point it should be stated that in both 1931-32 and 1932-33 the infection of the earlier plantings had had a much more severe effect on the health and productivity of the plants than was the case with the later plantings. For example, the planting made on 10th November,

1932, yielded practically no seed, whereas that planted on 10th December, though all plants were infected within ten weeks of planting, yielded at the rate of 8 bushels per acre.

Reference to the data for rainfall during the three seasons did not reveal any simple correlation betwen this element as usually measured and the progress of the disease. A summary of this data for Orbost for the three seasons during which the observations were made is given in Table II.

Consideration of the matter will show that any marked relation betwen rainfall measured in the way indicated and the incidence of the disease is not to be expected. The value of a rain in promoting infection depends not only on its amount, but also on the period over which it falls and on the temperature conditions during and subsequent to the rainfall. Some information based on experiments under controlled conditions on the relation of these features to the incidence of the disease has been obtained, but it is too soon yet to discuss these in relation to the meteorological data actually collected on the site and during the currency of the field trials.

Referring to the results of the time of planting trials as a guide to practice, some information can be gleaned.

Early planting, that is, before 15th November, should always be avoided. The outturn of a crop planted subsequent to this date depends very much upon the vagaries of the weather in the following three weeks or so. In this connexion, and with the kind assistance of Mr. H. Barkley, Assistant Director of the Commonwealth Weather Bureau, a study was made of the rainfall data for Orbost since 1900, but no evidence was secured to indicate that any one time within the four weeks following 20th November was likely to give the best results over a period of years.

Bean Crop affected by Bacterial Blight.

In these circumstances the best plan to adopt is to spread planting over a period which should not commence before 15th November at the earliest, and preferably a little later. At the latter end of the season, successful crops planted at about Christmas time have been seen, but with such late crops there is a risk of bad weather interfering with harvest operations.

2.—*Measures Aimed at the Production of Disease-free Plants.*

a. Trials with "Canadian Wonder" Seed from Different Sources.

These trials were commenced in 1931-32 in the hope that a line of seed free from disease would be found which could be used as a foundation stock to build up a supply of healthy seed. The seed for the purpose was obtained from local crops grown in isolated places and from New Zealand, Norfolk Island, France, and Hungary. Portion of the seed from these various sources was planted in plots each about

TABLE II.—MONTHLY RAINFALL AND NUMBERS OF DAYS ON WHICH RAIN FELL AT ORBOST FOR THE SUMMER MONTHS OF THE YEARS 1931-32, 1932-33, 1933-34.

Year.	November.		December.		January.		February.	
	Number of Days Rain Fell.	Amount (Points).	Number of Days Rain Fell.	Amount (Points)	Number of Days Rain Fell.	Amount (Points).	Number of Days Rain Fell.	Amount (Points).
1931–32	7	235	7	114	3	39	8	260
1932–33	7	111	10	228	7	156	2	28
1933–34	11	330	12	339	9	604	9	473
Average 50 years ..	8	227	8	265	7	272	6	230

1-12th acre, and separated from one another by two rows of thickly-planted maize. The land used for these plots had not had beans grown on it for five years.

Three weeks after planting, when the primary leaves were fully expanded, the young seedlings were examined for evidence of disease. Such evidence was found, with one exception, in every plot. Although these trials were not conducted under conditions which precluded insects spreading the disease, there was no evidence that such agents were active. The infections observed in all the plots corresponded with those occurring in seedlings raised from seed under conditions where insects were excluded. Difficulties were met with in securing further lots of "Canadian Wonder" seed from overseas, and the efforts to secure disease-free seed by these means were not persisted with.

b. Field Trials with Spacing and the Removal of Diseased Plants.

These trials were conducted during the 1931-32 season and continued in part the following season.

Field plots of eight rows, 3 chains long, were planted in three different ways, viz., in rows 27 inches apart, the ordinary way; in "hills" of 2-3 plants, 2 feet apart; and thirdly, in "hills" each 3 feet apart.

The dates when counts were made and the times when plants were removed are given in Table III. Where an infected plant was part of a "hill" the whole "hill" was removed. These removals were made during dry weather, and care was taken to avoid inoculating neighbouring healthy plants. In practice, it was found very difficult to observe all infected plants at a single inspection, and in most cases a second inspection was made soon after the first. Indeed, in some cases the plots had to be gone through three or four times at each inspection before all the plants showing evidence of infection could be detected.

Table III. gives the average number of plants per row and the average number of diseased plants per row found at each inspection at the times shown. From half of the plots the diseased plants were removed at the time of their counting. The seed used in these plots was obtained from a crop which just prior to harvest showed an average infection with "halo blight." The plots were planted on 15th November, 1931.

The plots were harvested on 1st March, 1932, after the last count and after the last diseased plants were removed. Seed from the plots where the plants were grown in "hills" and the diseased plants removed at each inspection were saved, and planted in isolated plots the following season. Diseased seedlings appeared in both plots.

The same general plot plan was adopted in the following season, though the experiment was extended to include trials with seed from three sources, all suspected of infection, but to different degrees. The plots were planted on 16th November, 1932. Results are set out in Table IV.

In this year it is clear that neither spacing of the plants alone nor its combination with the removal of diseased plants served to check appreciably the spread of the disease. It was concluded that the method was of no value for the development of disease-free plants under Victorian conditions.

3.—Seed Disinfection.

Experiments with seed disinfectants were carried out both in the laboratory and under field conditions. The principal object in the laboratory experiments was to narrow the field

TABLE III.—SHOWING THE NUMBERS OF DISEASED PLANTS AT DIFFERENT DATES IN PLOTS WHERE PLANTS WERE DIFFERENTLY SPACED, 1931-32.

How Planted.	Number of Plants per Row.	Treatment of Diseased Plants.	Diseased Plants Present on—					
			Dec. 8th.	Dec. 29th.	Jan. 12th.	Jan. 26th.	Feb. 10th.	March 1st.
Ordinary sowing ..	500	..	9	20	61	N.C.	132	N.C.
,, ,, ..	500	Removed	15	40	39	26	51	N.C.
In hills 2 feet apart..	125	..	..	13	18	29	35	24
,, ,, ,, ..	125	Removed	..	..	8	10	4	2
In hills 3 feet apart..	85	..	..	3	6	16	14	15
,, ,, ,, ..	85	Removed	..	7	5	8	2	2

N.C. indicates numbers not counted.

TABLE IV.—NUMBERS OF DISEASED PLANTS AT TWO DATES IN PLOTS WHERE THE PLANTS WERE DIFFERENTLY SPACED AND SEED FROM DIFFERENT SOURCES WAS USED.

How Planted.	Seed Sample Number.	Number of Plants per Row.	Treatment of Diseased Plants.	Diseased Plants Present on—	
				January 10th.	January 24th.
Ordinary planting	1	460	..	182	309
,, ,, ...	2	450	..	60	278
,, ,, ...	3	450	..	71	237
In hills 2 feet apart	1	123	..	79	104
,, ,, ,, ...	2	123	..	41	91
,, ,, ,, ...	2	123	Removed	40	60
In hills 3 feet apart	1	82	..	48	60
,, ,, ,, ...	2	80	..	22	54
,, ,, ,, ...	2	80	Removed	26	42

of available disinfectants to those likely to be useful in the field, and to obtain information on the best conditions for applying such disinfectants as appeared likely to be useful. In the earlier experiments, pure culture suspensions of the "halo blight" bacterium were used, but it was found that such suspensions could be inhibited by materials that were incapable of disinfecting infected bean seeds. Later on, a technique was developed in which infected bean seeds were suspended in the material to be tested, washed thoroughly, and then tested by cultural means for the presence of viable bacteria. This gave results approximating more closely to field behaviour, but this method also tended to place a disinfectant in a more favorable position than its merits for the purpose intended, warranted. It was suspected that the treated seed, despite the washing it was given, sometimes carried with it sufficient disinfectant to inhibit bacterial development in the cultural media used to demonstrate whether the organism was still viable or not. Ultimately it was found that the only satisfactory method of testing a disinfectant was to treat seed itself, to plant it in the ordinary way, and then count the numbers of diseased seedlings that developed after a certain length of time.

Besides its primary function of disinfection, an important quality in a satisfactory seed disinfectant in its effect on germination. Many materials when used at added concentrations, or when applied for longer periods, may improve in efficiency as disinfectants, but they may exercise more than a corresponding depressing effect on the germination of treated seed. This behaviour is exemplified in the case of the well-known disinfectant material, mercuric chloride. Thus in one small-scale field experiment with this material the results shown in Table V. were obtained.

TABLE V.—THE EFFECT OF MERCURIC CHLORIDE AT A CONCENTRATION OF 1–1500 AT ROOM TEMPERATURE (18–19° C.) FOR DIFFERENT PERIODS ON THE GERMINATION OF BEAN SEED AND ON THE AMOUNT OF "HALO BLIGHT" IN SEEDLINGS RAISED FROM SUCH SEED.

Period of Treatment in Minutes.	Germination.	Diseased Seedlings.
	%	%
30	93	1
80	87	3
120	45	1
240	19	Nil
Untreated dry seed ..	88	5

In this experiment only 100 seeds were planted in each plot under each treatment, and small differences in the germination figures and the differences in numbers of diseased seedlings must be discounted. It is clear that treatment with mercuric chloride 1–1500 for two hours does not eliminate infection, whilst germination both in percentage and vigour was greatly reduced. Treatment for four hours, while it possibly eliminates the disease, affects germination so severely that the treatment is valueless on this account.

It is unnecessary to detail the results of trials with all the different materials and the various concentrations and periods of treatment used. Table VI. gives a list of some of these materials, the maximum concentration, and the longest period for which they were applied in these trials. Under the conditions indicated, none of these materials was an effective disinfectant for the purpose in view.

TABLE VI.

Material.	Concentration.	Period of Application.
Malachite green* ..	1–500	3 hours
Brilliant green* ..	1–200	3 ,,
Methylene blue* ..	1–200	3 ,,
Methyl violet 2B* ..	1–200	3 ,,
Acridine orange* ..	1–200	3 ,,
Picric acid*	1–500	3 ,,
Trypaflavine (techn.)† ..	1–1,000	8 ,,
Diaminoacridine sulphate (techn.)†	1–1,000	8 ,,
Diaminoacridine nitrate† ..	1–1,000	8 ,,
"Chinosol"	1–500	2 ,,
"Tillantin"	1–500	2 ,,
Hydrogen peroxide ..	30 % (100 vols.)	3 ,,

* These materials, which, with the exception of Picric acid, are the commercial dyestuffs, were kindly supplied by the British Dyestuffs Corporation, Melbourne.

† These materials were kindly supplied by I.G. Farbenindustrie G.m.b.H., Leverkusen, Germany.

Trials with disinfectant dusts such as "Ceresan," "Agrosan," and "Tutan" also yielded no evidence of control.

A series of trials designed to test the effect of hot water treatment and of treatment with hot, dry air was also undertaken. With regard to the use of hot water, it has been reported (2) that a treatment of seed with water at 52° or 55° C. for 15 or 30 minutes, preceded by a soaking in tap water for twelve hours, gave promising results.

Most of the trials involving heat were done on a small scale in the field, using 200 to 500 seeds. These conditions provided satisfactory evidence regarding the effect of the treatment on germination. At the same time, an indication of the disinfectant value of the treatment was secured because infected seed was used throughout the trials. The figures given in Table VII. illustrate the type of results obtained with several hot water treatments that were tested.

Treatment with hot water at 45° C. for periods up to one hour apparently did not effect disinfection of the bean seed, while treatment with water at 50-52° C. seriously affected its germination under the conditions of the trial. From these results it did not appear that hot-water treatments would yield a practicable seed disinfection method, and more extensive trials were not undertaken.

With regard to hot dry air, it was found that the effect of any one treatment on germination was dependent on the moisture content of the seed prior to treatment. Thus in one trial no germination was secured in undried seed (17.9 per cent. moisture, 95 per cent. germination) after drying at 80° C. for two hours, whereas in a sample previously dried at 50° C. for 24 hours (8.4 per cent. moisture), and then dried at 80° C. for two hours, there was 71 per cent. germination. Again, after treatment at 100° C. for one hour there was no germination in a sample with 8.4 per cent. moisture, though 29

Left, a clean bean plant; right, bean plant affected by Bacterial Blight.

TABLE VII.—EFFECT OF TREATMENT WITH HOT WATER ON THE GERMINATION AND DISINFECTION OF BEAN SEED INFECTED WITH "HALO BLIGHT."

Date of Planting.	Number of Seeds Planted.	Treatment.	Pretreatment.	Germination Percentage.	Percentage Disease Days after Planting.	
					31.	34.
24.10.33 ..	500	Water at 45° C. for 30 minutes ..	At 15° C. for 6 hours	70	41	..
,, ..	500	,, 45° C. for 60 minutes ..	,, ,,	73	42	..
,, ..	500	,, 51–53° C. for 20 minutes	At 15° C. for 12 hours	11	Nil	..
,, ..	500	None	None	79	30	..
12.9.33 ..	200	Water at 50–52° C. for 15 minutes	At 20° C. for 3 hours	49	..	Nil
,, ..	200	,, 50–52° C. for 30 minutes	,, ,,	13	..	1
,, ..	200	,, 50–52° C. for 60 minutes	,, ,,	10	..	Nil
,, ..	200	,, at 20° C. for 3 hours ..	,, ,,	82	..	80

per cent. germination was obtained in a similar sample previously dried at 50° C. for eight days (3.9 per cent. moisture). One field trial to test the disinfectant effect of dry heat was conducted, and approximately 4,000 seeds in a plot of eight rows were planted. The seed used was an ordinary commercial sample, the degree of infection of which is indicated in the untreated plot. The results of this trial are given in Table VIII.

TABLE VIII.—SHOWING THE EFFECT OF DRY HEAT TREATMENTS ON INFECTED SAMPLE OF "CANADIAN WONDER"—FIELD TRIAL 1931.

Treatment.	Numbers of Diseased Seedlings per Row Nineteen Days after Planting.
Dried at 65° C. for 44 hours ..	3 ± ·8
Dried at 55° C. for 72 hours ..	6 ± 3·3
No treatment	10 ± 3·7

The best results in seed disinfection have been obtained through the use of organic mercurial disinfectants, particularly "Germisan," and to a lesser degree "Uspulun," both of which were used as steeps. Many trials with these materials, using different strengths and different periods for treatment, were carried out. It was found that rather dilute solutions applied for relatively long periods gave the best results. Table IX. refers to results of a field trial conducted in 1933. Actually detailed germination tests with the particular combination of concentration of disinfectant × period of treatment shown in this table were not done, and the remarks concerning germination were derived from the appearance of the stand in the field plots. The plots from which the results quoted in Table IX. were taken contained approximately 2,000 plants, and were established under ordinary field conditions. The seed used was a commercial sample of "Canadian Wonder." Except where otherwise shown, the seed was treated at room temperature (16-20°C.). Subsequent to treatment, the seed was dried by spreading it out on a sheet in the sun. It was dried sufficiently to permit of its being planted with the machine. This required 2-3 days. The plots were planted on 21st November, 1933.

TABLE IX.—NUMBERS OF DISEASED PLANTS PER THOUSAND PLANTS IN PLOT GROWN FROM BEAN SEED TREATED IN VARIOUS WAYS.

Treatment.	Number of Diseased Plants per Thousand.		Germination.
	20 Days after Planting.	41 Days after Planting.	
·6% Uspulun, 16 hours	0	131	Poor to fair
·05% Germisan, 16 hours	1	97	Good
·05% Germisan, 16 hours Seed dried, treatment repeated	2	52	Good
·05% Germisan, 6 hours ·1% Germisan at 45° C. for 30 minutes ..	2	44	Fair
·1% Germisan, 12 hours	1	33	Fair to good
No treatment ..	66	1,000	Good

These plots were destroyed by floods about eight weeks after planting, so that no information concerning the effect of treatment on final yield was obtained.

Discussion of Seed Disinfection.

The results just quoted show that by steeping "halo blight" infected seed for fairly long periods in dilute solutions of "Germisan" a considerable reduction in the numbers of diseased seedlings developing can be expected. Actually, the treatment, when considered in this respect, is probably of comparable efficiency to that of, say, copper carbonate in the reduction of bunt in wheat. The value of a method of seed treatment of the efficiency indicated for the control of "halo blight" remains to be considered.

In Table IX. the numbers of diseased plants 20 days after and 41 days after planting respectively are shown. In the interval there was from fifteen to an hundredfold increase in the numbers. A small amount of this increase may be due to the presence of seedlings primarily infected from the seed, but a much greater proportion undoubtedly arose as the result of secondary infection from primarily infected seedlings. Because of their destruction by a flood shortly after the date of the last inspection, later figures for the numbers of diseased plants in those plots were not obtained but in previous years counts of diseased plants were made at intervals up to harvest in similar kinds of plots. In these plots the differences in the numbers of diseased plants at the first count, due either to different seed treatments or to the use of seed from different sources, were often statistically significant, but this significance disappeared in the later counts. The rate at which these differences "flatten out" and disappear varies with the rate of spread of the disease, which depends, in turn, on the weather conditions experienced. In early-sown plots, which usually experienced the most favorable conditions for the spread of the disease, initial differences were quickly submerged. With conditions less favorable to the disease, the initial differences tended to persist, and were lost only in the last counts made.

There is another aspect of the question of the relative health of a crop at any particular moment that should be mentioned, though so far it has not been determined with any precision. It is suggested that under Victorian conditions the numbers of diseased plants at harvest time in plots having initial differences in these numbers tend to uniformity with the progress of time, but the amount of damage done to the crop as reflected in the yield depends on the number of diseased plants at any stage in the growth of the crop. Where numbers of diseased plants in the early stages of crop growth are high, the reduction in yield due to the disease is enhanced.

Bean pods showing typical "grease" spots.

From these remarks it is clear that there is still much room for additional experimental evidence on the effect on the ultimate health and yield of crops containing different numbers of diseased individuals and growing under different conditions, but we feel justified in forming an opinion on the value of seed disinfection. It is considered that seed disinfection under Victorian conditions is unlikely to yield a satisfactory method for raising disease-free plants, and hence of securing disease-free seed because—

(1) None of the treatments employed effected 100 per cent. elimination of the disease, and

(2) Any treatment less efficient than this permits of the development of diseased individuals from which, under the climatic conditions that may normally be expected to occur, such spreading of the disease may occur that a sufficient proportion of the crop becomes infected to ensure seed infection, and hence a perpetuation of the disease.

4.—Resistance to "Halo Blight."

"Canadian Wonder" is easily the most popular variety for the production of green beans under Victorian conditions. It crops heavily and continuously, producing large, fleshy pods. Unfortunately, it is very susceptible to "halo blight." In 1931-32 season, a number of green bush bean varieties, including the varieties "Sutton's Satisfaction," "Early Glory of Deuil," "Feltham's Prolific," and "Pale Dun" were secured and planted out under field conditions, and observations on their susceptibility to "halo blight" were made. All varieties were observed to be susceptible to infection, but "Pale Dun" appeared to suffer least damage, followed by "Feltham's Prolific." "Pale Dun" has since been observed growing under a wider range of conditions, and the conclusion reached that, compared with "Canadian Wonder," it possesses a considerable degree of resistance to "halo blight." For culinary purposes, however, the variety is much less suitable, the plant is less prolific, the pods are smaller, and, generally speaking, are not considered as of such good quality as those of the "Canadian Wonder." Similar objections are urged against the use of "Feltham's Prolific," and neither of these varieties finds much favour with growers.

Observations made in severely diseased crops of "Canadian Wonder" beans turned our attention to the possibility of securing strains within this variety, which, while possessing its principal horticultural advantages, were also resistant to "halo blight." In each season during which observations were made, but particularly in the 1932-33 season, when the disease was very severe, it was noticed that individual plants in an otherwise badly diseased crop were either free of infection or only slightly diseased. It was also observed that these plants, although they conformed to the general varietal characteristics of "Canadian Wonder," actually differed from the type regarded as the ideal striven after by the leading seed bean grower. Considerable variation between these special individuals existed, but the majority differed from the Orbost type of "Canadian Wonder" in the following characteristics:—They were later maturing, tended to produce their pods all at the one time ("one croppers") and the branches of the plant developed in a distinctive way. From the remarks that are to follow, it will be evident that segreglation and fuller study of these types is most desirable.

In the 1932-33 season a number of selections of seed of apparently resistant plants growing among badly diseased plants was made. In some cases, seed from a number of plants from the one field was bulked, in other cases the seed from individual plants was kept separately.

In the following year these selections were tested for their resistance under field conditions. These were made as favorable as possible for the development of "halo blight." The seed was planted in the field in rows a standard distance (27 inches) apart. Every third row was planted with "halo blight" infected "Canadian Wonder" beans which had been soaked in tap water for three hours prior to planting. This soaking greatly enhanced the number of infected seedlings that developed. Conditions favorable to the spread of the disease were ensured as far as possible by planting in the first week of November. The measure of success of these steps was shown by the fact that selections known to be susceptible to the disease, and included in the trials, were 100 per cent. infected within a month of the date of planting. Actually, as can be gathered from Table I.c., which shows the relation between planting date and the development of disease, the conditions for the spread of the disease during December were, if anything, rather more favorable than those in November, so that the figures given in Table X., which were obtained at the end of December, fairly represent the disease-resistant qualities of these selections.

The results in this table are expressed in terms of an arbitrary figure, the infection rating. In giving a plot its rating, two matters were taken into consideration: the number of lesions on plants in the plot and the effect of the disease on the vigour of the plants.

Where plants bore numerous lesions and were severely affected, the plot was rated 5, less numerous lesions and a decidedly less severe effect on plant growth was rated 4; decidedly less numerous lesions with little noticeable

effect on plant growth was rated 3; where some of the plants in a plot apparently bore no lesions and the rest very few lesions, the plot was rated 2; where the majority of plants were apparently disease-free and the remainder showed only one or two infection spots, the plot was rated 1. There were no plots in which the plants were altogether free from infection.

TABLE X.—SHOWING THE RELATIVE RESISTANCE OF A NUMBER OF SELECTIONS OF "CANADIAN WONDER" BEANS.—FIELD TRIAL, ORBOST, 1933.

Name or Number of Selection.	Infection Rating.	Remarks.
"Tweed Wonder" (N.S.W. selection)	5	
"Canadian Wonder"—		
Selection A	4	
Selection B	3	Mosaic disease present
Selection C	2	
Selection A100, N.S.W.	5	
Single plant, selection 1	3	Plants of poor vigour
Single plant, selection 3	2	Vigorous grower
Single plant, selection 4	5	Severely diseased
Single plant, selection 6	1	Vigorous, best plot in section
Single plant, selection 8	3	Mosaic present
Single plant, selection 13	3	Vigorous grower
Ordinary commercial ..	5	Severely diseased

The "Tweed Wonder" and selection A100 were supplied by the courtesy of the New South Wales Department of Agriculture, and were originally selected for resistance to anthracnose (*Colletotrichum lindemuthianum*). Selection A was a bulk sample made from seed collected from a number of apparently disease-free or lightly infected plants in a severely diseased crop. Selection B was derived from a sample maintained for many generations at the Burnley Horticultural Gardens. Selection C was secured from the survivors of a severely diseased plot which in turn had been planted with seed from a badly diseased crop of the previous year. The single plant selections were secured from apparently healthy plants found growing in bean fields badly diseased in 1932-33.

Unfortunately, all the plots referred to above were destroyed by a flood occurring in January, and all the seed was lost. Nevertheless, several matters arising from these results are worthy of notice and discussion—

(1) The "Canadian Wonder" variety as grown in Victoria, despite a uniformity in certain characteristics resulting from careful selection by seed growers, is not uniform in other directions. This lack of uniformity applies to certain horticultural characters, and also, it would appear, to relative susceptibility to "halo blight." It is suggested that there exists within the "Canadian Wonder" variety individuals possessing marked qualities of resistance, and that steps should therefore be directed to isolating and propagating such individuals.

(2) It is desirable that the first selections should be made from single plants, the produce of each single plant being planted in a separate plot. In these plots the horticultural suitability and vigour of the type as well as its comparative susceptibility to "halo blight" could be studied.

(3) The behaviour of selection C, and to some extent that of selection B, supplies interesting evidence on the effect of "natural" selection. Selection C, as has been pointed out, was seed from plants which in the two previous generations had been subjected to a very severe attack of "halo blight." As a consequence, the proportion of resistant to susceptible plants in the population had been greatly increased. This effect has been reflected in the average resistance of all the plants being raised above the normal for "Canadian Wonder."

Observations made in commercial fields indicate that a similar "natural" selection is taking place there, especially in places where the incidence of disease has been severe in the last few years. In these fields a new balance consequent on the introduction of a fresh biological element, "halo blight," is being adjusted slowly, and our aim in consciously selecting the more resistant types is simply to hasten and fulfil more completely this adjustment.

Selection B was from a sample developed under conditions isolated from other bean culture. There is no evidence to show that this line of seed had been selectively affected by "halo blight." It had been grown at Burnley

Horticultural Gardens from seed which for many generations previously had been grown there, and it had not been mixed with seed grown elsewhere. Actually the bulk of the crop each year was harvested for green beans, and a proportion of the plants in the later plantings was allowed to go to seed for next year's crop.

The seed developed under these circumstances, when compared with the Orbost type, produced a plant having distinct horticultural features, a greater resistance to "halo blight," and apparently a rather greater susceptibility to bean "mosaic," which at present is of no economic account at Orbost.

The field trials were carried out on the farm of Mr. G. H. D. Russell, of Bete Bolong, Orbost. Mr. Russell's thoroughness in the preparation of the land, its seeding and subsequent cultivation, and his care and assiduity in making meteorological observations, were particularly helpful.

SUMMARY.

1. An account is given of trials with measures for the control of "halo blight" of French beans, a disease which first assumed widespread importance in Victoria in the 1930-31 season.

2. It is shown that changes in the date of planting of seed drawn from the same sample may lead to considerable variation in the incidence of the disease as measured by the number of infected plants at regular intervals after planting. This variation is considered to be due to differences in weather conditions experienced immediately subsequent to planting. There is no evidence of any one limited time for planting which can be expected to give consistently good results over a period of years. It is considered that beans for seed purposes should not be planted before 15th November. Planting after Christmas involves a risk of bad weather during harvesting.

3. Trials with "Canadian Wonder" seed from various sources did not reveal any likely to be of use to growers as sources of disease-free seed.

4. Trials involving the growth of plants in the field spaced at different distances, combined with trials wherein diseased plants at these different spacings were removed at regular intervals, failed to yield evidence of a reliable method for obtaining disease-free seed.

5. An extensive series of trials designed to disinfect bean seed was conducted. Besides the attention given the usual disinfectants, dyestuffs and allied substances with reputed disinfectant qualities, and a few organic mercurial compounds, both in the form of steeps and dusts, were tested. Trials were also made with hot water and hot dry air treatments.

An attempt was made to devise a laboratory technique which would yield satisfactory evidence of the value of a material for bean seed disinfection purposes, but no method was considered reliable for the object in view.

Most of the trials upon which an opinion as to the value of a seed treatment are based were conducted in plots using naturally contaminated seed. These plots enabled an assessment to be made of—(*a*) the efficiency of the treatment for the disinfection of the seed, and (*b*) the effect of the treatment on germination. The trials with the more promising materials were conducted in plots with populations of from 2,000 to 4,000 plants. It was found that "Germisan," an organic mercurial compound used as a liquid seed steep, gave rather better results than "Uspulun," a similar class of compound, and that both these materials were more satisfactory for the purposes in view than any of the other materials tried. With these organic mercurial compounds best results were obtained where the seed was steeped in dilute solutions (0.05 per cent. to 0.1 per cent. Germisan) for fairly long periods (12-16 hours).

Although treatment of infected bean seed in the manner indicated effects a marked reduction in the number of diseased plants that can be ascribed to the use of infected seed, weather factors in the Victorian bean growing areas during the growth of the crop may operate in a way so favorable to the disease that the initial advantages in the shape of a reduction of infected plants as a result of seed disinfection may be lost.

It is considered that seed disinfection for Victorian-grown beans does not provide a likely means of securing "halo blight"-free seed.

6. Trials to test the relative resistance of different green bush bean varieties under field conditions have been conducted. The observations made indicate that "Pale Dun" in particular, and "Feltham's Prolific" to a less extent, were more resistant to "halo blight" than "Canadian Wonder."

Observations in badly diseased fields of "Canadian Wonder" beans revealed individuals apparently possessing considerable degrees of resistance to "halo blight." Trials conducted in the field where an intensive development of the disease was promoted on control plots showed that the progeny of some of these apparently resistant plants had retained that quality.

It is considered that the selection and study of these types on an individual plant basis offers the best avenue for a solution of the problem of "halo blight" in the French bean.

References.

1. Burkholder, W. H.: *Phytopath.* 16, p. 105. 1916.
2. Bremer, H., and Hahne, H.: *Nachrichtenblatt Deutsch, Pflanzenschutzdienst* XII., 5, p. 34. —abs. in *Rev. Appl. Myc.* 11, p. 687.

Butter Production and Export

The following tables show:—

(*a*) Factory production of butter and cheese in Victoria during July, August, September, and October, 1935, compared with the corresponding months of 1934, and

(*b*) Quantities and percentages of various grades of bulk butter examined in Victoria from 1st July to 30th November, 1935, in comparison with the corresponding period of 1934.

FACTORY PRODUCTION OF BUTTER AND CHEESE IN VICTORIA (QUANTITIES IN TONS).

Month.	Butter.		Cheese.	
	1935.	1934.	1935.	1934.
July	3,038	2,436	284	153
August	4,357	3,672	367	250
September	6,158	5,544	504	424
October	9,151*	7,394	683*	567
Totals four months	22,704	19,046	1,838	1,394

* Subject to adjustment.

BULK BUTTER EXAMINED FOR EXPORT IN VICTORIA (QUANTITIES IN TONS).

Period.	1935. How Graded.				Total.	Period.	1934. How Graded.				Total.
	Choice.	1st.	2nd.	Pastry.			Choice.	1st.	2nd.	Pastry.	
July 1–27 ..	576	178	55	5	814	July 1–28 ..	193	261	84	16	554
July 28 to August 31	1,187	433	115	12	1,747	July 29 to September 1	576	634	124	18	1,352
September 1–28	2,246	1,000	152	20	3,418	September 2–29	1,482	1,258	178	24	2,942
September 29 to November 2	4,610	2,468	437	42	7,557	September 30 to November 3	3,007	2,861	330	59	6,257
November 3–30	4,890	1,879	462	37	7,268	November 4 to December 1	3,264	2,714	386	37	6,401
Totals July 1 to November 30	13,509	5,958	1,221	116	20,804	Totals July 1 to December 1	8,522	7,728	1,102	154	17,506
Percentages ..	64.9	28.6	5.9	.6	..	Percentages ..	48.6	44.2	6.3	.9	..

Artificial Fertilizers Registered for 1936

Analyses and Unit Values

By W. C. Robertson, Chemist.

Superphosphate in store being handled with a mechanical shovel.

IT is the custom to publish in the January issue of the *Journal of the Department of Agriculture* each year the main list of brands of artificial fertilizers registered at the office of the Director of Agriculture, and also the unit values which are to be used during the year when calculating the commercial value of any fertilizer. These unit values are obtained from the analysis of the simple fertilizers as given in the registered brands by taking into account the percentage of the constituents which have a commercial value and the price charged per ton of the fertilizer.

The unit value of any plant food, or any particular form of plant food, is the average price charged for 1 per cent. per ton of fertilizer, the basis of the calculation being free on rail Melbourne or at the railway station nearest the place of manufacture. The following examples illustrate the method of calculating the value per ton of a fertilizer, using the unit value system:

Sulphate of Ammonia.

The nitrogenous fertilizer, sulphate of ammonia, contains the plant food, nitrogen, in the form of ammonia, the unit value for which is 11s. 1d. (see list). This means that every 1 per cent. of nitrogen in this particular fertilizer is worth that amount. Sulphate of ammonia is guaranteed to contain 20.6 per cent. of nitrogen, so that 20s. 6d. × 11s. 1d. = £11 8s. 4d. is the approximate maximum price f.o.r. Melbourne the farmer should pay for every ton of this fertilizer which he may purchase during the year.

View of modern tankage fertilizer works.

Tankage (Blood and Bone, etc.).

In the case of "Tankage," which is the term applied to the nitro-phosphatic fertilizers manufactured at freezing works and boiling-down establishments from refuse obtained during the slaughtering of stock, and which consists of blood, bone, meat, and offal, a double calculation must be made, because this type of fertilizer contains two plant foods, viz., nitrogen and phosphoric acid, and, in addition, the latter is present in two forms, i.e., as citrate soluble and as citrate insoluble.

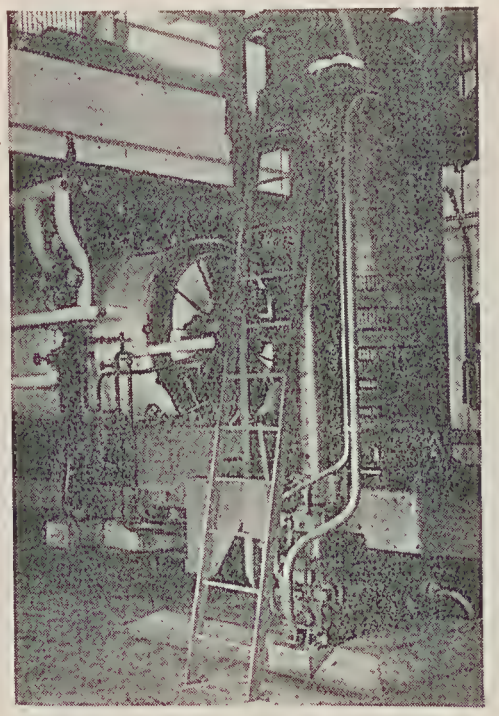
Assuming a brand of tankage to have a guarantee of 5 per cent. nitrogen in the organic form as tankage (blood, bone, meat, &c.), and 16 per cent. of phosphoric acid, 6 per cent. of which is in the citrate soluble form and the remaining 10 per cent. occurring as citrate insoluble, then the value per ton free on rail at Melbourne or the railhead nearest the works would be—

	£	s.	d.
5 per cent. nitrogen, at 18s. 2d. per unit	4	10	10
6 per cent. phosphoric acid as citrate soluble, at 4s. per unit	1	4	0
10 per cent. phosphoric acid as citrate insoluble, at 3s. 6d. per unit	1	15	0
Calculated value per ton ..	7	9	10

The approximate maximum value per ton of this brand of fertilizer (tankage) would, therefore, be £7 9s. 10d., and if offered at, say, £8 per ton the farmer, by calculating on the unit value system, could show that the price was too high, and refuse to do business.

A higher value is placed on phosphoric acid which is soluble in ammonium citrate solution (citrate soluble) than on the phosphoric acid which does not dissolve by this method (citrate insoluble). The reason for this is that agricultural chemists in the past, in seeking a solvent which would equal the soil solution in strength, chose ammonium citrate of definite concentration and neutrality, and this solution when used in fertilizer analysis is assumed to be equivalent to the soil solution in its solvent action. The citrate soluble phosphoric acid content of a fertilizer, therefore, is that portion which it is assumed would be readily available and, consequently, of immediate benefit to any tree, crop, or plant to which the fertilizer is applied. It follows that this form of phosphoric acid would be of greater value than the more insoluble form which is termed citrate insoluble.

This does not mean that the citrate insoluble phosphoric acid which is present in comparatively large amounts in this class of fertilizer is useless. Over a period of years the whole

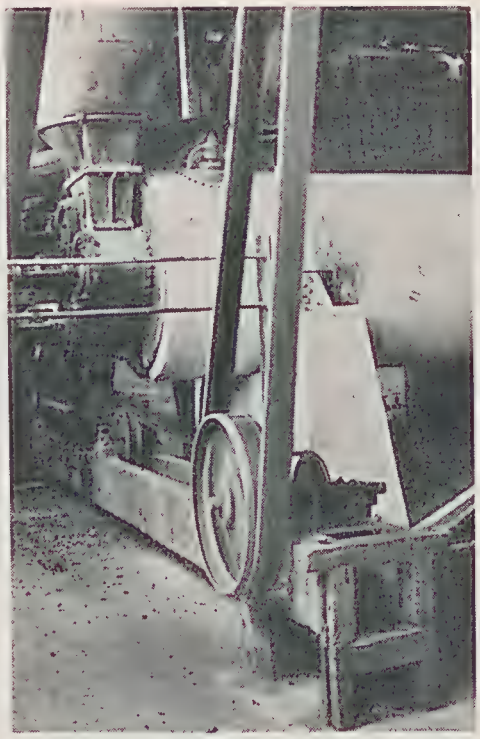


An up-to-date dry-rendering plant.

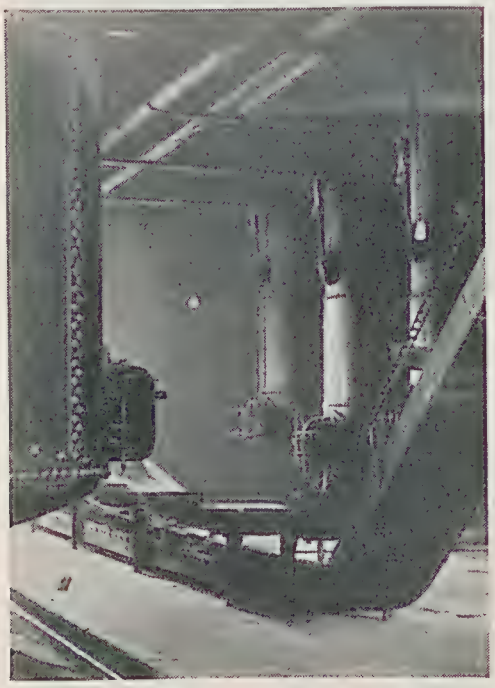
of the phosphoric acid content of blood and bone (tankage) would finally be rendered available, but from the stand-point of economy it is inadvisable to have capital lying idle for any length of time, and, further, in the case of a leasehold, the residual amount of phosphoric acid in the soil at the end of the lease may represent an appreciable sum of money.

Bonedusts.

To apply the unit value system to bonedusts it is necessary to obtain first the amount of phosphoric acid and nitrogen in the fertilizer in the form of coarse and fine bone respectively. This calculation is simple, as the following example will show:—A bonedust is guaranteed to contain 3.5 per cent. of nitrogen and 21.5 per cent. of phosphoric acid. The mechanical condition is guaranteed to be 60 per cent. fine bone and 40 per cent. coarse bone. To obtain the percentages of nitrogen and phosphoric acid which are present in the fine bone (this is necessary because of the difference in the unit value for plant food in fine bone and in coarse bone), multiply the percentage of nitrogen and phosphoric acid by the percentage of fine bone, and divide the result by 100. In the case quoted, 3.5 per cent. nitrogen × 60 per cent. fine bone = 210, which, when divided by 100, gives 2.1 per cent. nitrogen as fine bone, and 3.5 (percentage of total nitrogen) minus 2.1 leaves 1.4 per cent. of nitrogen as coarse bone.



Revolving dryer—old process—for treating "hashmagandy."



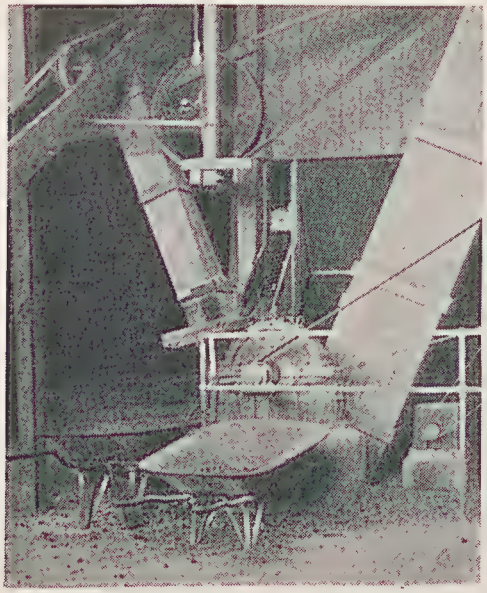
Tankage manufacture—A battery of digesters used in removing tallow from raw offal.

Similarly, to obtain the percentage of phosphoric acid as fine bone, 21.5 (percentage of phosphoric acid) × 60 (percentage of fine bone) = 1290, which, divided by 100 = 12.9 per cent. of phosphoric acid as fine bone and 21.5 (percentage of total phosphoric acid) minus 12.9 (percentage as fine bone) = 8.6 per cent. phosphoric acid as coarse bone.

To convert to monetary value per ton:—

	£	s.	d.
2.1 per cent. nitrogen as fine bone at 18s. 2d. per unit	1	18	2
1.4 per cent. nitrogen as coarse bone at 16s. per unit	1	2	5
12.9 per cent. phosphoric acid as fine bone at 4s. 9d. per unit ..	3	1	3
8.6 per cent. phosphoric acid as coarse bone at 3s. 7d. per unit ..	1	10	9
Calculated value per ton ..	7	12	7

It should be remembered, however, that any calculation made by the unit value system is mainly comparative. When applied to organic fertilizers such as tankage (blood and bone),



Crushing mill and elevators used in the manufacture of blood and bone.

the calculated value may not be a true reflection of the commercial value of the fertilizer. This type of fertilizer to a large extent is the by-product from freezing works, and as such its value is a fluctuating quantity.

Manufacture of Tankage.

Every year the tankage (blood and bone) class of artificial fertilizer dominates the list of registered brands. The greater part of the annual tonnage is produced over a definite period, and the main objective of the manufacturer is not to carry over any large stock of material which, in money value at any rate, is of secondary importance. This means that tankage is very often obtainable at a discount on the price registered.

In recent years the Department of Agriculture has been well aware of this fact, but, providing the farmer receives the full benefit of the cut in the price charged per ton, there is no cause for complaint. It is as well, however, for dealers and storekeepers, who retail these fertilizers at prices far exceeding the registered price, to recognize that it may be found expedient to request them to make application to the Department for a registered brand, and to fulfil all the requirements of the Fertilizers Act as the vendor of the fertilizer.

The approximate number of brands registered with the Department annually is 120, and of these at least one in every four represents a tankage fertilizer, yet the annual tonnage of the fertilizer produced and sold in Victoria probably would not exceed 15,000 tons. It is estimated that for every ton of blood and bone used in the State during 1935, approximately 25 tons of superphosphate and other fertilizers would be sold.

Tankage fertilizer is manufactured from the refuse, blood, and offal of the abattoirs, freezing works, and boiling-down establishments. The raw offal is first steam-digested under pressure to remove the tallow, and the residue, termed "hashmagandy," is then dried in steam-heated revolving cylinders, after which it is elevated or transferred to a disintegrator, where it is ground to a more or less fine homogeneous powder. Finally, it is bagged direct from the mill, or conveyed to storage sheds for subsequent bagging and disposal.

This method of treatment, which is known as the wet method, is now being displaced in some works by what is known as the "dry-rendering" process, which consists of pressing the previously cooked offal in a powerful press to extract the tallow, and subsequently grinding the press-cake. The latest method has many advantages over the old method, and not the

The storage and bagging shed at a modern tankage fertilizer works.

least is its cleanliness and the freedom from obnoxious odour of the finished product. However, in the latter connexion it might be observed that many of the stalwart users of this class of fertilizer regularly judge its quality on the obnoxiousness of its odour.

The "dry-rendered" fertilizer is usually lower in its percentage of fat than that produced by the wet method, and this is a matter of importance both to the manufacturer and consumer. To the former because the higher tallow extraction, together with the improvement in quality, means lower costs, and to the latter because the higher the fat content in the fertilizer the slower the rate of decomposition, which is probably due to the tallow forming a water-proof coating over the fertilizer particles, and thereby retarding the formation of available plant food.

Tankage, or blood and bone, is a fertilizer largely used in intense culture where the heavy dressings give such a splendid response after the subsequent irrigation and frequent cultivations which are so essential to success in this phase of agriculture.

Unit Values Compared.

There is little difference in the unit values for 1936 when compared with those current in 1935, excepting in the cases of sulphate of ammonia, bonedust, and the potash fertilizers.

The unit value for ammonia has fallen 1s., from 12s. 1d. to 11s. 1d., equivalent to 8¼ per cent.—an appreciable fall in favour of the farmer, but not nearly so marked as the fall in the unit value of the potash salts, which show a decrease of more than 25 per cent. on the previous year's figures.

Phosphoric acid, in organic fertilizers such as tankage and bonedusts, which is always the dearest source of supply, is inclined to ease, particularly is this so in the case of bonedust, which shows a reduction of approximately 14 per cent. in the unit value of phosphoric acid as fine bone, and 20 per cent. for that present as coarse bone.

Comparative prices in Victoria and England are shown in the accompanying table.

PRICES AT HOME AND ABROAD.

—	Victoria.	England.
	Per ton. £ s. d.	Per ton. £ s. d.
Nitrate of Soda	13 10 0	7 12 6
Sulphate of Ammonia ..	11 7 0	7 5 0
Nitro Chalk	11 15 0	7 5 0
Superphosphate	..	2 12 6*
,, ...	3 15 0	3 17 0†
Sulphate of Potash ..	13 10 0	9 6 0
Muriate of Potash	11 10 0	7 16 0
Tankage	7 10 0	6 5 0 to 7 15 0
Bonedust	7 15 0	6 15 0
Dried Blood	10 0 0 to 11 0 0	13 0 0

* 14 per cent. water soluble phosphoric acid.
† Calculated to 20.5 per cent. phosphoric acid.

Fertilizers Act 1928 (No. 3680).

UNIT VALUES FOR THE YEAR 1936.

	£ s. d.
Nitrogen, organic, as Blood; Blood and Bone; Blood, Bone, and Flesh; and Fine Bone ..	0 18 2
,, as Nitrate	0 17 7
,, as Coarse Bone and in Bone Fertilizers	0 16 0
,, as Ammonia	0 11 1
Phosphoric Acid—	
as Water Soluble	0 3 5
as Citrate Soluble—	
in Blood and Bone, Blood, Bone and Flesh, and Animal Fertilizer and in Mixed and Complete Fertilizers containing either or both of the foregoing	0 4 0
in all other Fertilizers	0 3 0
as Citrate Insoluble—	
in Blood and Bone, Blood, Bone and Flesh, and Animal Fertilizers, and in Mixed and Complete Fertilizers containing either or both of the foregoing	0 3 6
in other Mixed Fertilizers and in Ground Phosphate	0 2 2
in other Fertilizers	0 1 0
as Fine Bone	0 4 9
as Coarse Bone	0 3 7
Potash—	
as Sulphate	0 5 7
as Chloride	0 4 7

W. R. JEWELL, M.Sc., F.I.C.,
Chemist for Agriculture.

Melbourne, 1st December, 1935.

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THE RAILWAY DEPARTMENT GOODS SHEDS are adjacent to and connected with the Cool Stores by direct lines ; delay and exposure of produce through shunting in the Spencer-street yards, or cartage, are thus avoided. The Stores are situated in close proximity to the Victoria Dock, where vessels drawing up to 30 feet of water can be berthed ; excellent facilities for the efficient and economical treatment and shipment of frozen and perishable products are provided.

EXPERT OFFICERS are connected with every Branch, so that any one requiring information regarding the production, preparation, and shipment of produce can rely upon being promptly supplied with up-to-date information upon all matters.

RATES for treatment and storage may be obtained on application to the Exports Superintendent, Department of Agriculture, Produce Offices, 605 Flinders Street, Melbourne, C.3.

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1936.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Nitrogenous—														
Readily available.														
Nitrate of Soda	Sickle in diamond	15·50	..	..	..	..	15·50	..	..	..	..	..	13 10 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
,, ,,	Cresco ..	15·00	..	..	..	..	15·00	..	..	..	..	..	13 10 0	Cresco Fertilisers Ltd., Geelong
,, ,,	Pivot ..	15·50	..	..	..	..	15·50	..	..	..	..	..	13 10 0	Phosphate Co-operative Co. of Aust. Ltd., 447 Lit. Collins-st., Melb.
Sulphate of Ammonia	M.G. Co. in diamond	..	20·59	..	..	..	20·59	..	..	..	..	..	11 2 9	The Metropolitan Gas Co., 196 Flinders-st., Melb.
,, ,,	Sickle in diamond	..	20·60	..	..	..	20·60	..	..	..	..	..	11 8 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
,, ,,	Cresco ..	..	20·00	..	..	..	20·00	..	..	..	..	..	11 8 6	Cresco Fertilisers Ltd., Geelong
,, ,,	Pivot ..	..	20·60	..	..	..	20·60	..	..	..	..	..	11 8 6	Phosphate Co-operative Co. of Aust., Ltd. 447 Little Collins-st., Melb.
Nitro Chalk† ..	Sickle in diamond	7·75	7·75	..	..	..	15·50	..	..	..	..	..	11 15 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
Moderately available.														
Dried Blood ..	Imperial in diamond	..	..	12·00	..	..	12·00	..	..	·75	·75	·50 (Unspecified)	9 10 0	W. Angliss and Co. (Aust.) Pty.Ltd., 42 Bourke-st., Melb.
,, ,,	Pannifex ..	..	..	12·00	..	..	12·00	..	..	..	·50	1·10 (Unspecified)	11 0 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melb.
,, ,,	T. B. and S. in diamond Brooklyn	..	..	11·60	..	..	11·60	..	..	..	..	..	10 0 0	Thos. Borthwick and Sons (A/asia) Ltd., 84 William-st., Melb.
,, ,,	M.C.C. in diamond	..	..	11·50	..	..	11·50	..	..	..	..	..	9 10 0	Melbourne City Council, Town Hall, Melb.
Blood Manure ..	Cockbill's ..	..	..	8·50	..	..	8 50	..	..	..	1·00	..	9 10 0	W. and J. Cockbill, trading as J. Cockbill, 407 P.O. Place, Melb.
,, ,,	M.C.C. in diamond	..	..	8·00	..	..	8·00	..	..	..	..	..	6 15 0	Melbourne City Council, Town Hall, Melb.
,, ,,	Nifex ..	..	..	7·50	..	..	7·50	..	..	..	1·00	·25 (Unspecified)	7 15 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melb.
,, ,,	Sickle in diamond	..	..	7·50	..	..	7·50	..	..	..	..	..	8 10 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
Slowly available.														
Castor Meal ..	Alba ..	..	..	..	..	..	4·50 (As castor meal)	..	..	2·25	2·25	·75 (Unspecified)	3 15 0	Lycett Propty. Ltd., Normanby-rd., Montague
,,	L.F.X. ..	..	..	..	..	..	4·50 (As castor meal)	..	..	2·25	2·25	·75 (Unspecified)	3 15 0	Lawford's Fruit Exchange Pty. Ltd., Williamson's-rd., Doncaster
,, ,, ..	Sweetsoil ..	..	..	..	..	..	4·50 (As castor meal)	..	..	2·25	2·25	·75	3 15 0	Sweetsoil Lime and Fertiliser Pty. Ltd., 19 Queen-st., Melb.
Wool Waste ..	A.L.T. ..	..	..	..	..	..	3·85 (Unspecified)	..	..	..	·70	·31	3 0 0	A. L. Thompson Pty. Ltd., 49 Grant-st., South Melb.
Phosphatic—														
Readily available.														
Superphosphate 22 per cent.	Lomaco ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3 10 0	New Zealand Loan and Mercantile Agency Co. Ltd., 535 Collins-st., Melb.

† This fertilizer also contains approximately 50 per cent. carbonate of lime.

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1936—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
Phosphatic—Readily available—continued.		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Superphosphate 22 per cent.	Cockbills ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3 10 0	W. and J. Cockbill, trading as J. Cockbill, 407 Post Office-place, Melb.
„ „	Sickle in diamond	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3 15 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Cresco ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3 15 0	Cresco Fertilisers Ltd., Geelong
„ „	Pivot ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3 15 0	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Moderately available.														
Basic Phosphate	Sickle in diamond	..	..	..	..	..	..	..	15·50	3·20	18·70	..	4 15 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Pivot ..	..	..	..	..	..	..	..	15·50	3·00	18·50	..	4 15 0	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Super. and Rock Phosphate	Sickle in diamond	..	..	..	..	..	..	10·00	·50	18·50	29·00	..	4 5 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Pivot ..	..	..	..	..	..	..	10·00	·50	18·50	29·00	..	4 5 0	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
„ „	Cresco 50/50 Phosphate	..	..	..	..	..	..	9·16	1·84	17·40	28·40	..	4 5 0	Cresco Fertilisers Ltd., Geelong
Slowly available.														
Ground Phosphate	Sickle in diamond (80%)	..	..	..	..	..	..	..	..	36·65	36·65	..	4 0 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Pivot (very fine)	..	..	..	..	..	..	..	..	36·50	36·50	..	4 0 0	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
„ „	Pivot ..	..	..	..	..	..	..	..	..	36·50	36·50	..	3 15 0	„ „ „ „
Potassic—Readily available.														
Sulphate of Potash	Cresco ..	..	..	..	..	..	..	..	..	..	..	48·50	12 17 6	Cresco Fertilisers Ltd., Geelong
„ „	Sickle in diamond (90%)	..	..	..	..	..	..	..	..	..	..	48·50	13 17 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Pivot ..	..	..	..	..	..	..	..	..	..	..	48·50	13 17 6	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
Muriate of Potash	Sickle in diamond (80%)	..	..	..	..	..	..	..	..	..	..	50·00 (as chloride)	12 0 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Cresco ..	..	..	..	..	..	..	..	..	..	..	50·00 (as chloride)	11 0 0	Cresco Fertilisers Ltd., Geelong
Containing Nitrogen and Phosphoric Acid—Readily available.														
Super. and Ammonia	Sickle in diamond (6 and 1)	..	2·90	..	..	..	2·90	17·50	·40	·90	18·80	..	5 9 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Sickle in diamond (3 and 1)	..	5·00	..	..	..	5·00	15·40	·30	·80	16·50	..	6 5 0	„ „ „ „
„ „	Sickle in diamond (2 and 1)	..	6·87	..	..	..	6·87	13·66	·34	·66	14·66	..	6 18 0	„ „ „ „
„ „	Sickle in diamond (1 and 1)	..	10·30	..	..	..	10·30	10·25	·25	·50	11·00	..	8 2 6	„ „ „ „
„ „	Cresco (6 and 1)	..	2·85	..	..	..	2·85	17·48	·42	·85	18·75	..	5 9 6	Cresco Fertilisers Ltd., Geelong
„ „	Cresco (3 and 1)	..	5·00	..	..	..	5·00	15·37	..	1·13	16·50	..	6 5 0	„ „ „ „
„ „	Cresco (2 and 1)	..	6·87	..	..	..	6·87	13·66	·34	·66	14·66	..	6 18 0	„ „ „ „
„ „	Cresco (1 and 1)	..	10·30	..	..	..	10·30	10·25	·25	·50	11·00	..	8 2 6	„ „ „ „
„ „	Pivot I. ..	..	2·90	..	..	..	2·90	17·40	·40	·80	18·60	..	5 9 6	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1935—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
Containing Nitrogen and Phosphoric Acid—Readily available—continued.		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Super. and Ammonia	Pivot II." ..	..	5·00	..	..	..	5·00	15·30	·30	·80	16·40	..	6 5 0	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
" "	Pivot II. (A) ..	..	6·80	..	..	..	6·80	13·60	·30	·60	14·50	..	6 18 0	" " " "
" "	Pivot III. ..	..	10·00	..	..	..	10·00	10·20	·20	·50	10·90	..	8 2 6	" " " "
Nitro - Superphosphate	Sickle in diamond	..	1·50	..	..	·50	2·00	16·70	1·10	2·00	19·80	..	5 17 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
" "	Cresco ..	..	1·50	..	·50	..	2·00	16·39	1·10	1·70	19·19	..	5 17 6	Cresco Fertilisers Ltd., Geelong
Moderately available.														
Ammonia and Rock Phosphate	Cresco ..	..	2·00	..	..	..	2·00	8·30	1·60	15·70	25·60	..	5 5 6	" " "
Blood, Bone, and Super	Sickle in diamond	..	..	..	..	2·50	2·50	12·51	1·43	2·96	16·90	..	6 2 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
"	Cockbill's ..	..	..	..	2·50	..	2·50	12·51	1·43	2·96	16·90	..	7 10 0	W. and J. Cockbill, trading as J. Cockbill, 407 Post Office-place, Melb.
Bone and Super	J. A. Dundas..	..	..	..	..	2·25	2·25	9·99	5·16	5·58	20·73	..	7 0 0	J. A. Dundas, Dynon-rd., Footscray
" "	Sickle in diamond, No. 1	..	..	..	..	2·00	2·00	11·40	3·00	5·30	19·70	..	6 5 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
" "	Cresco, No. 1..	..	..	..	2·00	..	2·00	9·50	3·90	3·00	16·40	..	6 5 0	Cresco Fertilisers Ltd., Geelong
" " "	Apex ..	..	..	..	..	..	1·62 (as bone)	10·25	3·25	8·50	22·00	..	6 10 0	North-Eastern Bone Products, Wangaratta
Super and Bone	Sickle in diamond, No. 2	..	..	..	..	1·00	1·00	16·00	1·80	3·10	20·90	..	5 12 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
" "	Cresco, No. 2 ..	..	..	..	..	1·00	1·00	16·10	1·10	3·60	20·80	..	5 12 6	Cresco Fertilisers Ltd., Geelong
Bone Fertilizer and Super.	Elsworth's ..	..	..	..	..	..	1·50 (as bone)	11·00	2·50	5·00	18·50	..	5 12 6	Eureka Fertiliser and Flock Mills, cr. York and Joseph sts., Ballarat
Blood and Bone	Arch No. 1 ..	..	..	..	7·00	..	7·00	..	5·00	5·00	10·00	..	8 0 0	Amalgamated Freezing Co. (Vict.) Pty. Ltd., 54 Market-st., Melb.
" "	Arch No. 2 ..	..	..	..	8·00	..	8·00	..	4·00	3·00	7·00	..	8 0 0	" " " "
" "	J. A. Dundas	..	..	..	..	4·50	4·50	..	7·14	13·61	20·75	..	8 0 0	J. A. Dundas, Dynon-rd., Footscray
" "	Sickle in diamond	..	..	..	..	5·00	5·00	..	6·00	10·00	16·00	..	7 10 0	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
" "	Cresco ..	..	..	..	..	5·00	5·00	..	3·00	11·50	14·50	..	7 10 0	Cresco Fertilisers Ltd., Geelong
" "	Corio ..	..	..	..	4·00	..	4·00	..	6·00	8·00	14·00	..	6 10 0	The Corio Trading Co. Pty. Ltd., 164 Moorabool-st., Geelong
" "	Pridham's ..	..	..	..	5·40	..	5·40	..	8·50	5·50	14·00	..	6 10 0	W. Pridham Pty. Ltd., Evans-st., Braybrook
" "	Apollo ..	..	..	..	5·00	..	5·00	..	4·00	12·00	16·00	..	8 0 0	J Kitchen and Sons Pty. Ltd., Ingle-st., Port Melb.
" "	Imperial in diamond	..	..	..	..	5·00	5·00	..	5·00	11·00	16·00	..	6 10 0	W. Angliss and Co. (Aust.) Pty. Ltd., 42 Bourke-st., Melb.
" "	Fertillo ..	..	..	..	..	6·00	6·00	..	6·00	9·00	15·00	..	8 15 0	Glues and By-Products Pty. Ltd., 86 King-st., Melb.
" "	Ibis ..	..	..	..	..	4·00	4·00	..	7·90	8·10	16·00	..	6 12 6	Ficken, Halliday, and McLelland Pty. Ltd., 91 Swan-st., Richmond.
" "	T.B. and S. in diamond (Lighthouse)	..	..	..	6·00	..	6·00	..	5·00	2·00	7·00	..	7 10 0	Thomas Borthwick and Sons (A/asia) Ltd., 84 William-st., Melb.
"	T.B. and S. in diamond (Brooklyn	..	..	..	6·00	..	6·00	..	6·00	6·00	12·00	..	7 10	" " "

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1936—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
Containing Nitrogen and Phosphoric Acid—Moderately Available—contd.		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Blood and Bone	Fitzgerald's ..	..	..	..	5·25	..	5·25	..	5·50	9·00	14·50	..	7 10 0	P. Fitzgerald and Sons, Oakleigh
,, ,,	Fitzgerald's (Animal Fertilizer)	..	..	..	..	3·75	3·75	..	5·75	13·25	19·00	..	7 10 0	,, ,, ,, ,,
,, ,,	Apex ..	..	..	..	..	5·00	5·00	..	5·00	10·00	15·00	..	8 0 0	North-Eastern Bone Products, Wangaratta
,, ,,	Cockbill's ..	..	..	..	..	5·25	5·25	..	3·00	9·00	12·00	..	8 10 0	W. and J. Cockbill, trading as J. Cockbill, 407 Post Office-place, Melb.
,, ,,	Pannifex's Oak	..	..	..	..	6·90	6·90	..	4·00	5·50	9·50	..	8 10 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melb.
,, ,,	Pennifex's No. 2	..	..	..	..	7·17	7·17	..	5·00	6·99	11·99	..	9 0 0	,, ,, ,, ,,
,, ,,	Pannifex's No. 3	..	..	..	..	5·50	5·50	..	5·00	10·00	15·00	..	8 0 0	,, ,, ,, ,,
,, ,,	Pannifex's No. 4 (Animal Fertilizer)	..	..	..	..	6·00	6·00	..	5·00	7·00	12·00	..	8 0 0	,, ,, ,, ,,
,, ,,	Pannifex's No. 5	..	..	..	..	8·00	8·00	..	3·00	5·00	8·00	..	8 10 0	,, ,, ,, ,,
,, ,,	Pannifex's No. 6 (Animal Fertilizer)	..	..	..	..	6·00	6·00	..	6·00	10·00	16·00	..	8 0 0	,, ,, ,, ,,
,, ,,	Pannifex's No. 7 (Animal Fertilizer)	..	..	..	..	4·00	4·00	..	7·00	9·00	16·00	..	6 15 0	,, ,, ,, ,,
,, ,,	Pannifex's No. 8 (Animal Fertilizer)	..	..	..	..	4·75	4·75	..	6·50	12·50	19·00	..	7 15 0	,, ,, ,, ,,
,, ,,	W. and M. in circle	..	..	..	6·00	..	6·00	..	4·50	6·25	10·75	..	6 2 6	Western and Murray Co-operative Bacon and Meat Packing Co. Ltd., 522 Flinders-lane, Melb.
,, ,,	Cockatoo ..	..	..	..	4·56	..	4·56	..	5·90	5·88	11·78	..	6 0 0	Richard Fordham, Camperdown
,, ,,	Eclipse ..	..	..	..	2·98	..	2·98	..	9·96	6·86	16·82	..	7 5 0	Thomas Albert Mills, Spec Gully, Golden Square
,, ,,	Tongala ..	..	..	..	..	4·36	4·36	..	6·25	6·84	13·09	..	6 10 0	Leonard L. Russell, Tongala
,, ,,	Valley ..	..	..	..	9·30	..	9·30	..	1·90	3·30	5·20	..	6 10 0	Goulburn Valley Freezing Works, Shepparton
,, ,,	A.N.A. Surprise (Animal Fertilizer)	..	..	..	..	5·00	5·00	..	4·00	10·00	14·00	..	7 10 0	G. W. Pennell, Burke-st., Braybrook
Bone Fertilizer..	Elsworth's ..	..	..	..	..	4·00	4·00	·50	5·80	11·70	18·00	..	6 10 0	Eureka Fertiliser and Flock Mills, cr. York and Joseph sts., Ballarat
,, ,,	Newnham's ..	..	..	..	..	..	2·51 (as bone)	..	2·92	15·38	18·30	..	5 10 0	Newnham's Pty. Ltd., Bacon Factory, Guthridge-parade, Sale
Mixed Manure	Humo-Phos. ..	..	1·28	..	1·03 (as organic)	..	2·31	..	..	5·46	5·46	..	4 0 0	Peninsula Lime and Fertiliser Co. Pty. Ltd., 70 Elizabeth-st., Melb.
, ,,	Organite ..	..	1·00	..	4·50 (as leather meal)	..	5·50	3·00	..	..	3·00	..	7 3 0	Organite Pty. Ltd., 450 Smith-st., Collingwood
Containing Nitrogen, Phosphoric Acid and Potash.														
Complete Manure	Sickle in diamond (Market Garden)	..	1·70	..	..	1·50	3·20	10·30	2·40	4·20	16·90	2·42	7 7 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
, ,,	Sickle in diamond, No. 1	..	1·00	..	..	1·40	2·40	10·90	2·20	3·90	17·00	5·00	7 2 6	,, ,, ,, ,,
, ,,	Sickle in diamond, No. 2	..	1.00	..	..	1·00	2·00	14·80	·40	·70	15·90	4·80	6 17 6	,, ,, ,, ,,

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1936—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
Containing Nitrogen, Phosphoric Acid and Potash—contd.		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Complete Manure	Sickle in diamond (A) (5.1.1)	..	2·90	..	..	..	2·90	14·60	·40	·70	15·70	6·90	6 17 6	Commonwealth Fertilisers and Chemicals Ltd., 65 William-st., Melb.
„ „	Sickle in diamond (B) (5.2.1)	..	5·00	..	..	..	5·00	12·80	·30	·60	13·70	6·00	7 15 0	„ „ „ „
„ „	Sickle in diamond (C) (4.4.1)	..	9·15	..	..	..	9·15	9·11	·22	·44	9·77	5·39	9 0 0	„ „ „ „
„	Sickle in diamond (D) (2.2.1)	..	8·24	..	..	..	8·24	8·20	·20	·40	8·80	10·00 (as muriate)	9 7 6	„ „ „ „
„ „	Cresco (Market Garden)	..	1·50	..	1·56	..	3·06	11·65	1·49	3·26	16·40	2·42	7 7 6	Cresco Fertilisers Ltd., Geelong
„ „	Cresco No. 1 ..	..	1·00	..	1·40	..	2·40	11·25	2·00	4·50	17·75	5·00	7 2 6	„ „ „ „
„ „	Cresco No. 2 ..	..	9·15	..	..	..	9·15	9·11	·22	·44	9·77	5·39	9 0 0	„ „ „ „
„ „	Cresco No. 3 ..	..	5·15	..	..	..	5·15	12·81	·31	·63	13·75	6·06	7 15 0	„ „ „ „
„ „	Cresco No. 4 ..	..	8·24	..	..	..	8·24	8·20	·20	·40	8·80	10·00 (as muriate)	9 7 6	„ „ „ „
„ „	Pivot IV. ..	..	2·90	..	..	..	2·90	14·30	·30	·70	15·30	6·90	6 17 6	Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melb.
„ „	Pivot V. ..	..	8·20	..	..	..	8·20	8·20	·20	·40	8·80	9·60	9 7 6	„ „ „ „
„ „	Pivot VI. ..	..	9·10	..	..	..	9·10	9·10	·20	·40	9·70	5·30	9 0 0	„ „ „ „

Description of Fertilizer.	Brand.	Nitrogen.	Phosphoric Acid.	Mechanical Condition.		Price asked per ton.*	Where Obtainable.
				Fine Bone.	Coarse Bone.		
		%	%	%	%	£ s. d.	
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W. R. JEWELL, M.Sc., F.I.C.,
Chemist for Agriculture.

Imperial Economic Committee (*Continued from page 33*)—

Over and above this, it has published regularly every week its Dairy Produce Notes and Fruit Intelligence Notes, and every month its Wool Intelligence Notes, and its Canned and Dried Fruits Notes (with a weekly supplement giving arrivals). In addition, annual summaries reviewing for the year the trade of the United Kingdom, and other principal importing and exporting countries, with statistics of production in the chief producing countries, are issued as supplements free to the subscribers to the appropriate Notes, and are also available for separate sale. Between the 1st October, 1933, and the 31st March, 1935, the number of subscribers to these Intelligence Services rose from 1,636 to 2,007.

The Committee is now Imperial in the fullest sense, since it is controlled and financed by all parts of the Empire, is available to examine and report on any economic question which the governments of the Empire may agree to refer to it, and provides regular economic intelligence services of value to all parts of the Empire. Mr. F. L. McDougall, C.M.G. (Australia), is chairman for the current year.

Orchard and Garden Notes

By Edward E. Pescott, F.L.S., Senior Horticultural Instructor.

Phlox Drummondi.

The Flower Garden.

THE production of winter-flowering annuals is a necessity in most gardens, and although we are in midsummer, now is the time to attend to the sowing of the seed. Seed of sweet pea (winter), Iceland poppy, wallflower, mignonette, stock, pansy (early), primula, and others, should now be sown.

A light sandy seed-bed should be prepared, into which some old leaf mould has been worked. The seed, except that of the sweet pea, may be loosely scattered into the surface soil of the bed. Sweet peas should be sown about three-quarters of an inch deep.

After sowing, some dry leaves or very old manure should be well rubbed and scattered on the surface of the bed. This loose covering must be maintained as long as the seed is germinating.

Seedlings should not be manured or over-watered when in the seed-bed; this induces too "leggy" a growth, and makes transplanting difficult. They thrive best when transplanted if they have been grown for a few weeks under "hard" conditions in a seed-bed.

The Orchard.

Citrus growers will do well if they noted the incidence of red scale on their trees. The period has arrived for definite action in checking this pest, which is very insidious in its ravages.

Red scale is more easily controlled when in the "crawler" stage, and both spraying and fumigation should be considered. The "crawlers" are very easily scattered by winds or by birds, and wind-carried insects have been observed for a distance of over 6 chains—that is, through and past fifteen or twenty trees.

Where infestation is light, a spraying is recommended with white oil 1 in 35 in January, and another a month later if necessary. This treatment is also to be given in suburban gardens.

There is no doubt that under "grove" conditions, eradication is more successful with cyanogas fumigation. A bulletin on Fumigation of Citrus Trees is available from this Department on application.

The Vegetable Garden.

This month's work is twofold—seed sowing for winter crops and abundant watering for the coming crop.

Asparagus cutting will have ceased, and the beds should now be well manured. It will be an advantage to incorporate some sulphate of potash in the mixture. During summer the beds should be frequently watered, so as to induce a vigorous growth.

Rhubarb and horseradish plants should now be both manured and watered. It is hardly possible to overfeed rhubarb.

Tomatoes should be manured and watered. Where only a few plants are grown, it is advisable to stake them, so that the whole of the plant shall receive a maximum of sunshine. Too many side shoots must not be allowed, and most of the laterals should be pinched out when the plants are quite small.

French bean seed may still be sown for late crops. It will respond quickly to manure in the soil. Climbing French beans should be well supported by stakes, and both bush and climbers may have one application of lime.

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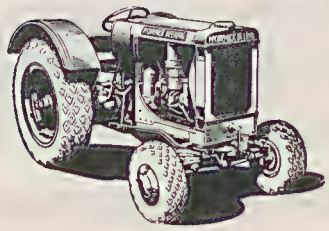

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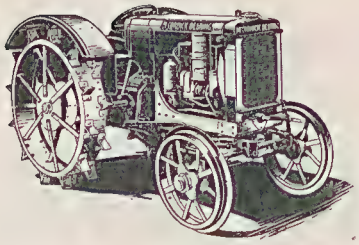

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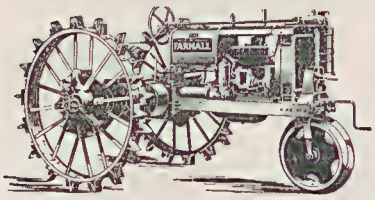

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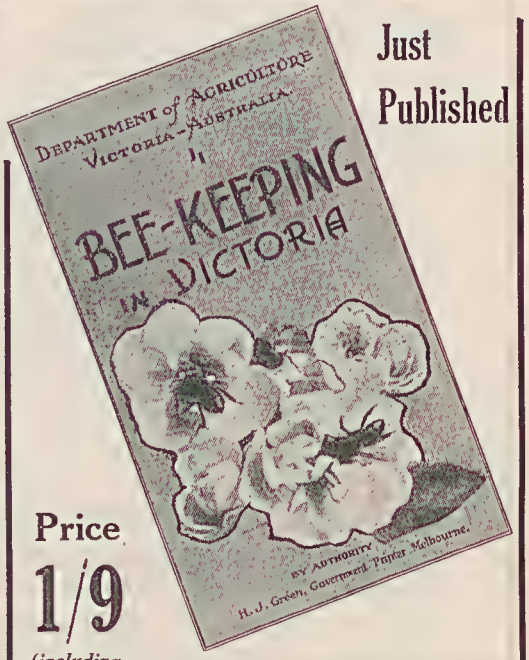

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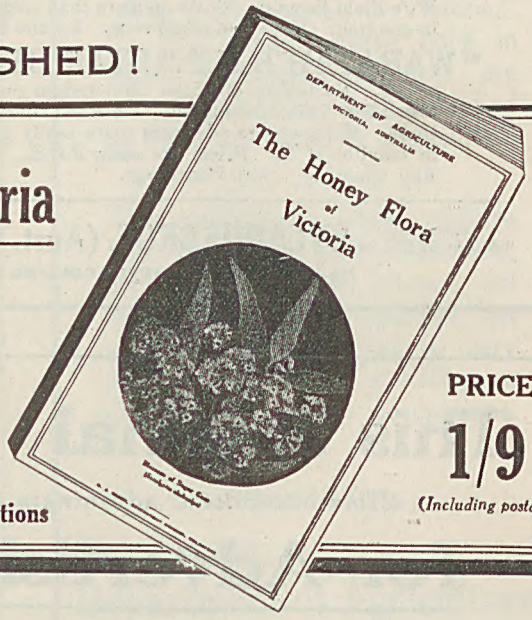

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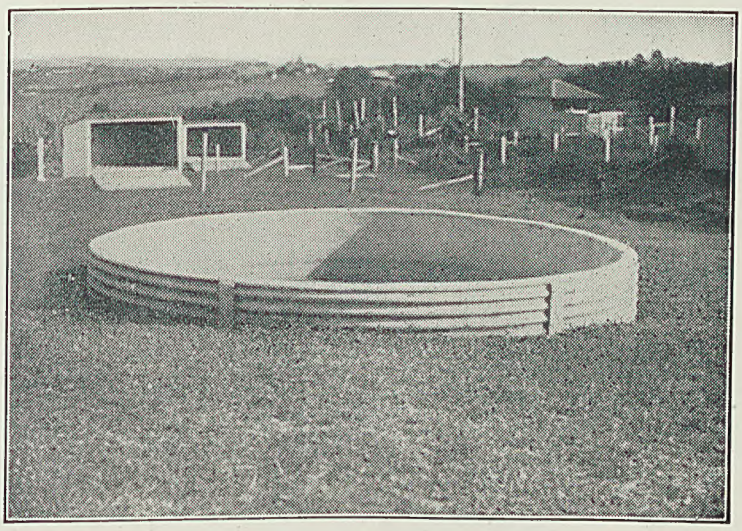

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